

ANNUAL REPORT FOR 2000



**Dismal Swamp Mitigation Site
Gates / Perquimans County
Project No. 6.129003T
TIP No. R-2208 WM**



Prepared By:
Natural Systems Unit & Roadside Environmental Unit
North Carolina Department of Transportation
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SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Dismal Swamp Mitigation Site. This site was constructed in 1996.

Monitoring activities in 2000 represent the second year of monitoring. The site must demonstrate vegetation and hydrological success for a minimum of three consecutive years.

The site is monitored with forty-eight vegetation plots, twenty-six groundwater gauges, one surface gauge and two rain gauges.

One major change in the hydrologic monitoring process is the installation of an infinity rain gauge. These gauges were installed because in the past existing on-site rainfall gauges have proven unreliable. Data recorded by the rain gauge will be used for comparison to the daily groundwater readings. Daily rainfall recorded at an Elizabeth City rain gauge, maintained by the NC State Climate Office will be obtained for to produce the 30-70-percentile graph.

Hydrologic monitoring indicates that almost the entire site has met success criteria during the 2000-monitoring year. Nineteen of the twenty-six monitoring gauges met the hydrologic criteria. The surface water gauge has shown appreciable surface water throughout the entire growing season. The 30-70-percentile graph indicates relatively normal rainfall for the 2000-growing season.

Vegetation monitoring yielded a successful total average tree density of 552 trees per acre across the four-planted zones.

Based on the monitoring results from the 2000 season, NCDOT recommends that monitoring continue.

1.0 INTRODUCTION

1.1 Project Description

The Dismal Swamp Mitigation Site is located along the Gates and Perquimans County lines (COE ID # 199401492). It is 1.2 miles east of Sandy Cross on SR 1002 (Folly Road) (Figure 1). The site encompasses approximately 612 acres of farm and forest communities.

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of three years. The following report details the results of hydrologic and vegetative monitoring during 2000 at the Dismal Swamp Mitigation Site.

1.3 Project History

Summer 1996	Grading Construction - Majority of Ditches Filled; Mowing; Discing
Jan.-Feb. 1997	Tree Planting
February 1997	Monitoring Wells Installed
March – November 1997	Hydrologic Monitoring (1 yr.)
July 1997	Stake Test Plots & Initial Vegetation Monitoring
November 1997	Vegetation Monitoring (1 yr.)
March – November 1998	Hydrologic Monitoring (2 yr.)
October 1998	Vegetation Monitoring (2 yr.)
November 1998	Grading Construction - Main Canal Ditch (Phase II)
February 1999	Tree Planting (Phase II)
March – November 1999	Hydrologic Monitoring (1 yr.)
November 1999	Vegetation Monitoring (Restart)(1 yr.)
March 2000	Herbicide Treatment
March – November 2000	Hydrologic Monitoring (2 yr.)
October 2000	Vegetation Monitoring (2 yr.)

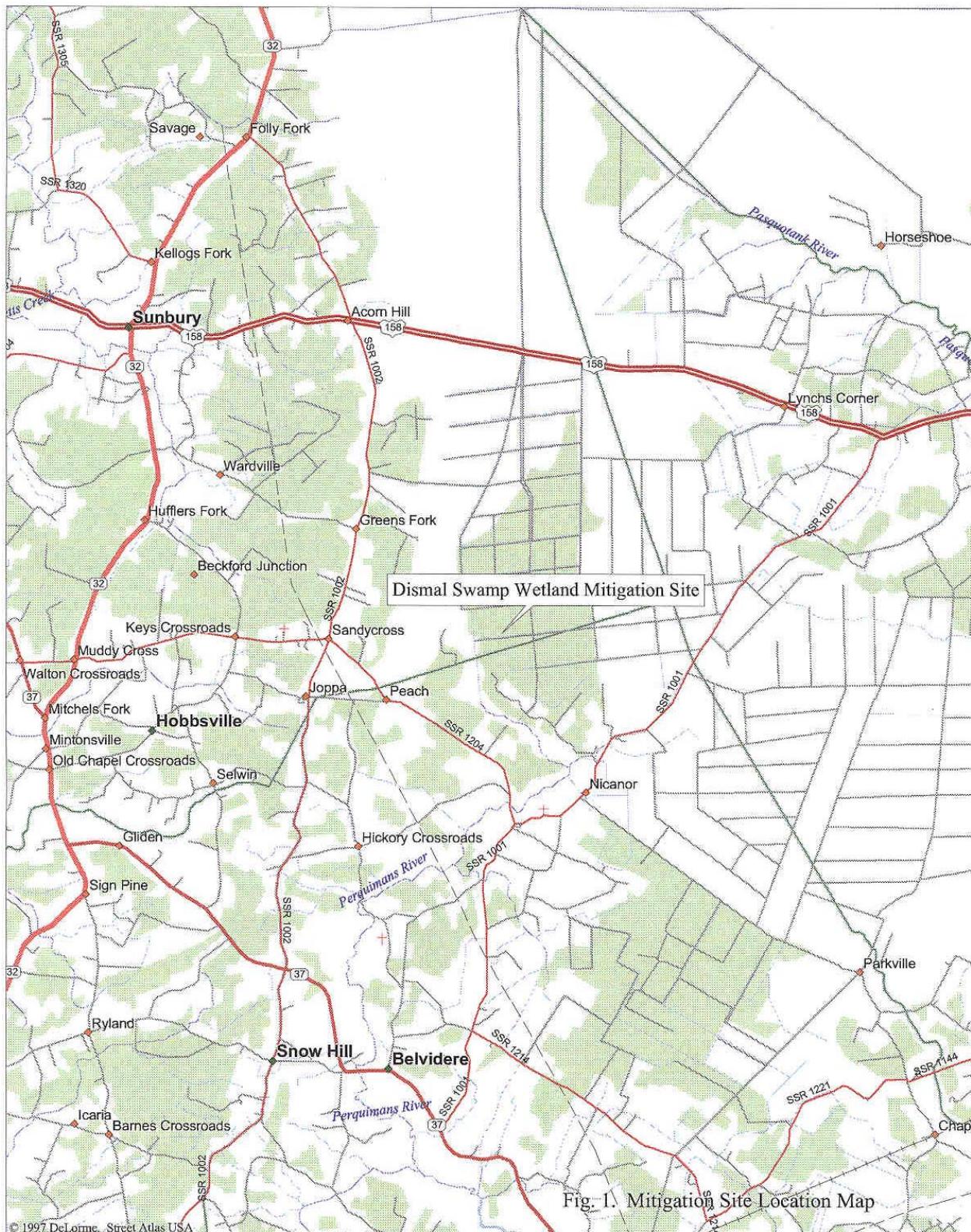


Fig. 1. Mitigation Site Location Map

2.0 HYDROLOGY

2.1 Success Criteria

Target hydrological characteristics include saturation or inundation within 12 inches of the surface for at least 12.5% of the growing season at lower landscape positions, during average climatic conditions. Upper landscape reaches and areas near perimeter canals may exhibit surface saturation/inundation for between 5% and 12.5% of the growing season based on well data. These 5%-12.5% areas are expected to support hydrophytic vegetation within organic soils of low permeability. If wetland parameters are marginal as indicated by vegetation and hydrology monitoring, consultation with COE personnel will be undertaken to determine jurisdictional extent in these transitional areas. One gauge was placed in an upland area where saturation is expected to be less than 5% of the growing season, in order to aid future delineation of true wetland area. Table 1 summarizes the wetland criteria expected for each monitoring gauge.

Table 1
EXPECTED SITE CONDITIONS

Expected Percent of the Growing Season with Saturated Conditions	Monitoring Well Number
≥ 12.5%	2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26
5% to 12.5%	7, 12, 27
0% to 5%	25

The growing season in Gates County begins March 25 and ends November 11. The dates correspond to a 50% probability that temperatures will drop to 28° F or lower after March 25 and before November 11.¹ The growing season is 232 days; the optimum duration for wetland hydrology is 29 consecutive days. Local climate must represent average conditions for the area in order for the hydrologic data to be considered valid.

2.2 Hydrologic Description

Twenty-six groundwater-monitoring gauges, two rain gauges, and one surface water gauge were installed on site in 1997 (Figure 2). The monitoring gauges record daily readings of groundwater depth. The rain gauges were replaced in spring 2000 with infinity rain gauges.

Appendix A contains a plot of the groundwater depth for each monitoring gauge. Data determined to be erroneous was omitted; therefore, some gaps appear in the plots.

¹ Soil Survey of Gates County, North Carolina, Soil Conservation Service, p.93.

DISMAL SWAMP MITIGATION SITE
GATES, PERQUIMANS COUNTIES

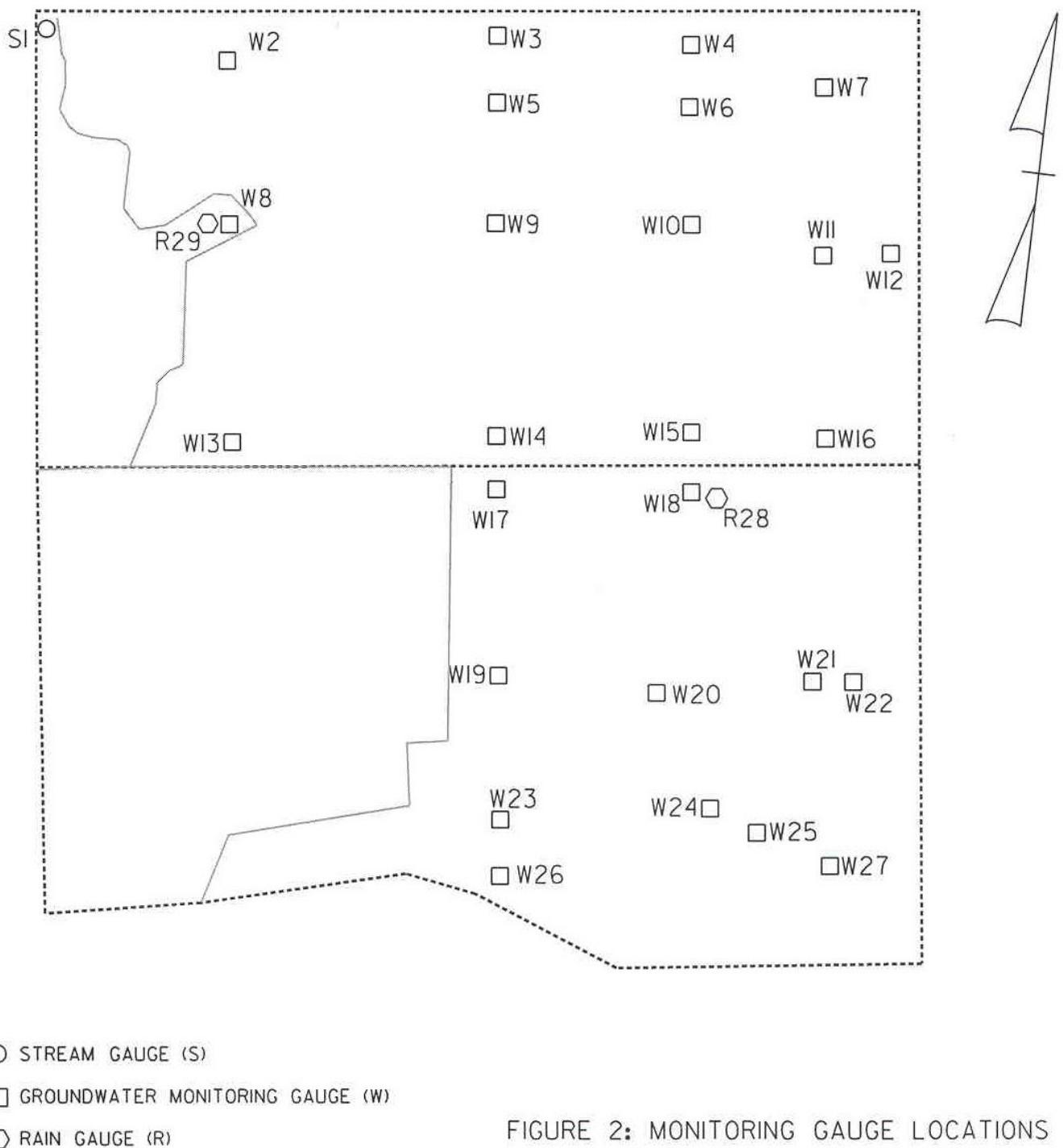


FIGURE 2: MONITORING GAUGE LOCATIONS

Precipitation events are included on each graph as bars. The rainfall plotted was obtained from the on-site infinity rain gauge.

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

The largest number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 232-day growing season. Table 2 shows the hydrologic results for the 2000-growing season.

Table 2
2000 HYDROLOGIC MONITORING RESULTS

Monitoring Gauge	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Date
DS-2				✓	91.4	Mar. 25 – Oct. 22
DS-3				✓	14.2	Jul. 25 – Aug. 26
DS-4			✓		12.1	Jul. 25 – Aug. 21
DS-5				✓	21.5	Mar. 25 – May 13
DS-6				✓	21.5	Mar. 25 – May 13
DS-7		✓			5.2	Aug. 28 – Sept. 8
DS-8				✓	88.4	Mar. 25 – Oct. 15
DS-9				✓	89.2	Mar. 25 – Oct. 17
DS-10				✓	24.6	May 17 – Jul. 12
DS-11				✓	66.4	May 21 – Oct. 21
DS-12			✓		12.1	Jul. 25 – Aug. 21
DS-13			✓		8.2	Apr. 15 – May 3
DS-14			✓		12.1	Jul. 24 – Aug. 20
DS-15				✓	90.1	Mar. 25 – Oct. 19
DS-16				✓	25.9	Jul. 20 – Oct. 17
DS-17				✓	99.6	Mar. 25 – May 26
DS-18				✓	94.8	Mar. 25 – May 22
DS-19				✓	61.2	Mar. 25 – Aug. 13
DS-20				✓	13.4	Apr. 11 – May 11
DS-21				✓	90.1	Mar. 25 – Oct. 19
DS-22				✓	62.1	May 21 – Oct. 11
DS-23				✓	37.5	Jul. 16 – Oct. 10
DS-24				✓	12.5	Jul. 25 – Aug. 22
DS-25		✓			5.3	Aug. 28 – Oct. 8
DS-26				✓	12.9	Jul. 25 – Aug. 23
DS-27			✓		12.1	Jul. 25 – Aug. 21

DISMAL SWAMP MITIGATION SITE
GATES, PERQUIMANS COUNTIES

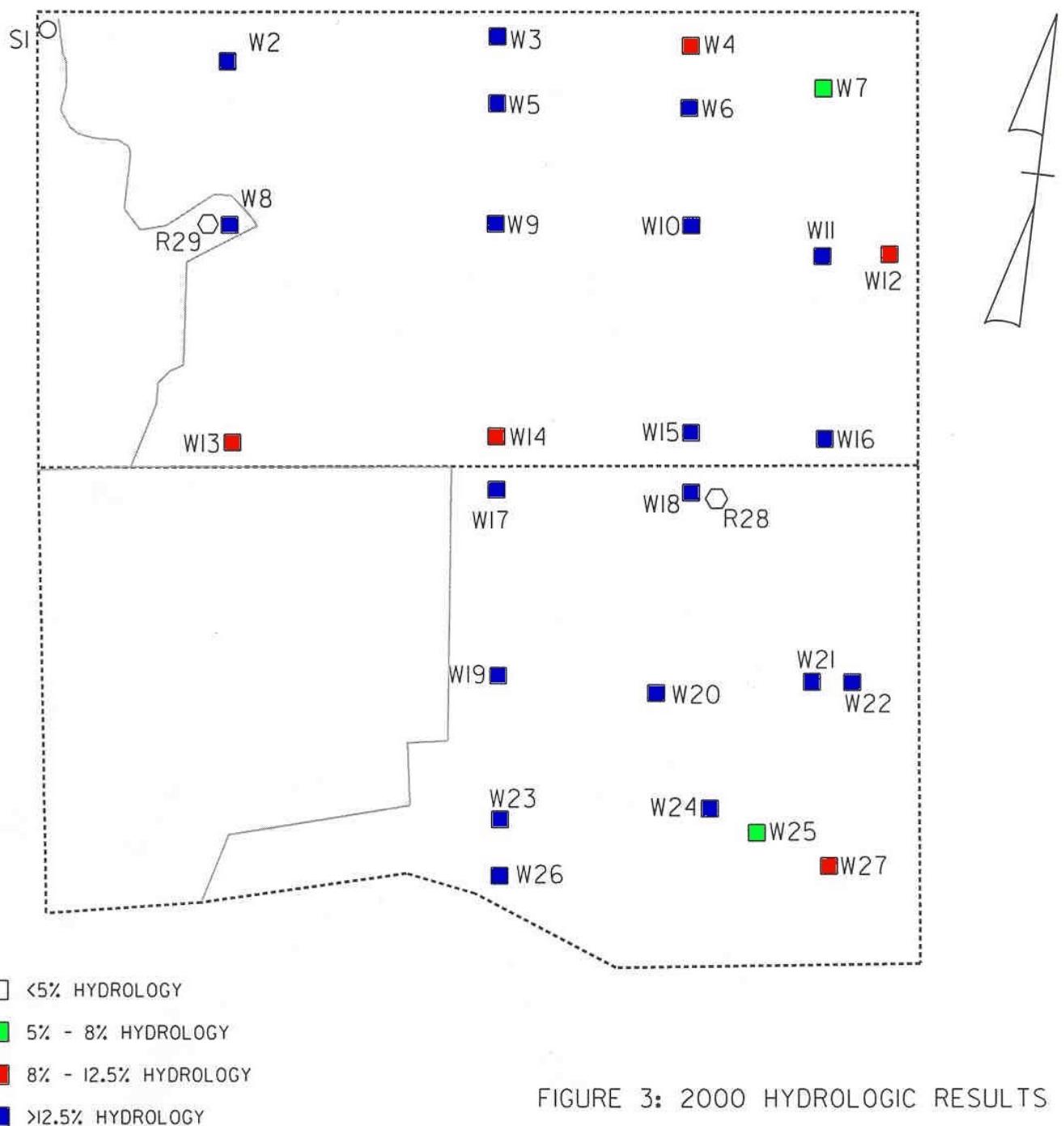


FIGURE 3: 2000 HYDROLOGIC RESULTS

Gauges 19 and 20 displayed several difficulties during the growing season due to dead batteries. Each time the batteries were replaced and the gauge reset. Gauge number 20 was removed and replaced during the November download.

Figure 3 is a graphical representation of the 2000 hydrologic results. A blue dot indicates hydrology for greater than 12.5% of the growing season; a red dot means the gauge showed between 8% and 12.5%. A green dot indicates hydrology between 5% and 8% of the season. It is this hydrologic data which will determine the success of the site. The surface water gauge has recorded appreciable surface water throughout the growing season.

2.3.2 *Climatic Data*

Figure 4 is a comparison of 1999 and 2000 monthly rainfall to historical precipitation for the area. The two lines represent the 30th and 70th percentiles of monthly precipitation for Elizabeth City, NC. These percentiles represent monthly rainfall data collected between 1931 and 1998 from a National Climatic Data Center rain gauge. The 1999 and 2000 monthly rainfall data was provided by the State Climate Office of North Carolina at NC State University. Because of data availability, the 2000 rainfall encompasses precipitation through November 2000. The 2001 annual report will include a 30-70-percentile graph with the monthly rainfall from November and December of 2000.

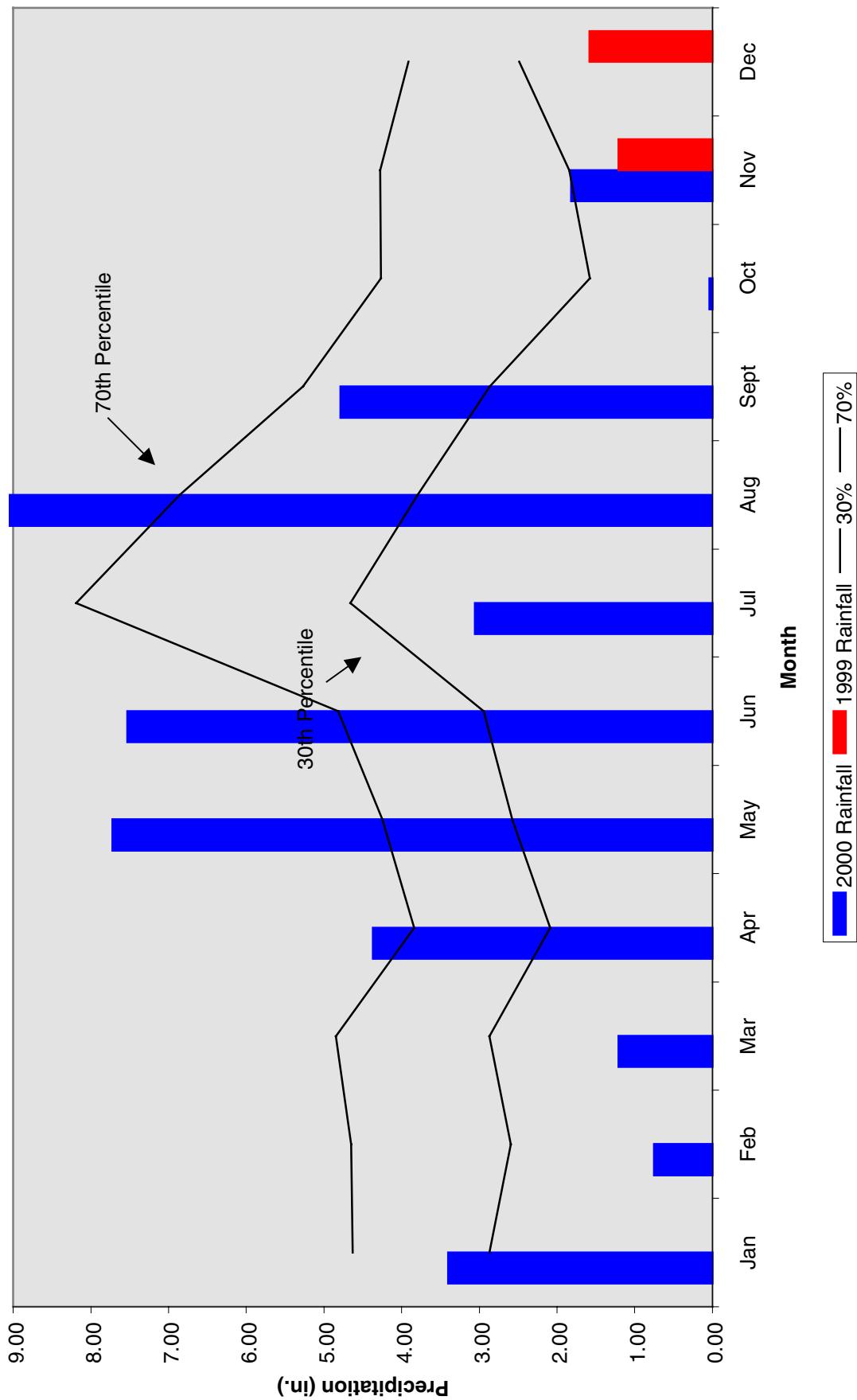
Rainfall for the Elizabeth City vicinity in the past two years ranges from below average to above average.

2.4 Conclusions

The data for the 2000-growing season indicates that nineteen of the twenty-six monitoring gauges met the success criteria. Gauges 4, 13, and 14 did not meet their expected hydrologic criteria while many of the gauges met well above expectations. Gauge number 4 registered within the success criteria for 12.1% of the 2000-growing season and has shown significant improvement over the 1999-growing season. Gauges number 13 and 14 are located along the area where the large canal was filled in across the middle of the site. Gauge 14 has shown some improvement while gauge 13 continues to meet success criteria only around 8.2% of the growing season. It has been noted that even though gauge 13 lies near the floodplain area, no ponding is occurring at this location.

The Dismal Swamp Mitigation Site made large strides in 2000 showing more favorable hydrologic trends than in 1999. The few exceptions appear to be centralized in specific areas along the outer perimeter of the site.

Figure 4: Dismal Swamp 30-70 Percentile Graph



3.0 VEGETATION: DISMAL SWAMP MITIGATION SITE

3.1 Success Criteria

NCDOT will monitor the site for five years. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5). The number of plants of one species will not exceed 20% of the total number of plants of all species planted.

3.2 Description of Species

The following species were planted in the Wetland Restoration Area:

Zone 1: Non-riverine Swamp Forest / Atlantic White Cedar (136 acres)

Taxodium distichum, Bald Cypress
Nyssa aquatica, Tupelo Gum
Nyssa sylvatica var. biflora, Swamp Blackgum
Chamaecyparis thyoides, Atlantic White Cedar
Fraxinus pennsylvanica, Green Ash
Quercus laurifolia, Laurel Oak
Quercus falcata var. pagodaefolia, Cherrybark Oak
Quercus michauxii, Swamp Chestnut Oak
Quercus phellos, Willow Oak

Zone 2: Coastal Fringe Sandhill Forest (12 acres)

Nyssa sylvatica, Black Gum
Quercus marilandica, Blackjack Oak
Quercus virginiana, Live Oak
Pinus palustris, Longleaf Pine
Carya tomentosa, Mockernut Hickory
Quercus cocinea, Scarlet Oak
Quercus michauxii, Swamp Chestnut Oak
Quercus laevis, Turkey Oak

Zone 3: Non-riverine Swamp Forest Mineral Soil Subtype (315 acres)

Taxodium distichum, Bald Cypress
 Nyssa sylvatica var. biflora, Swamp Blackgum
 Chamaecyparis thyoides, Atlantic White Cedar
 Fraxinus pennsylvanica, Green Ash
 Quercus laurifolia, Laurel Oak
 Quercus falcata var. pagodaefolia, Cherrybark Oak
 Quercus michauxii, Swamp Chestnut Oak
 Quercus phellos, Willow Oak
 Liriodendron tulipifera, Yellow Poplar

Zone 4: Riverine Swamp Forest (34 acres)

Taxodium distichum, Bald Cypress
 Nyssa aquatica, Tupelo Gum
 Nyssa sylvatica var. biflora, Swamp Blackgum
 Quercus lyrata, Overcup Oak
 Chamaecyparis thyoides, Atlantic White Cedar
 Fraxinus pennsylvanica, Green Ash
 Quercus laurifolia, Laurel Oak

3.3 Results of Vegetation Monitoring

Table 3

	Plot #	Green Ash	Willow Oak	Laurc Oak	Cherrybark Oak	Tulip Poplar	Bald Cypress	Tupelo Gum	Atlantic White Cedar	Swamp Blackgum	Southern Red Oak	Swp Chestnut Oak	Longleaf Pine	Scarlet Oak	Blackgum	Turkey Oak	Overcup Oak	Blackjack Oak	Live Oak	Total (3 year)	Total (at planting)	Density (Trees/Acre)
ZONE 1	13	3	1	6	1		11	3	2	6		1								34	34	680
	14	2	4	5	1		7					9								28	30	635
	15	2	1	12	1		6		5											27	35	525
	16	5	9				8	7	3											32	37	588
	23	5	2				11		2		1									21	28	510
	24	2	3	1			12		3	9										30	32	638
	26	1	3		1		13	3	4		3									28	28	680
	31	3	3				14			6										26	34	520
	32	4		1	2		20			3							1			31	41	514
	33	2	2	2			7		13					1		3				30	33	618
	42	7	3	3	3		4		2	6										28	28	680
	43	11					18				1									30	38	537
	47	5	1	9	2				1								2		20	25	544	
	ZONE 1 AVERAGE DENSITY																				590	
ZONE 2	12	1										17	3		1		2		24	24	680	
	29											2	2	1	2			5	6	18	24	510
	ZONE 2 AVERAGE DENSITY																				595	

3.3 Results of Vegetation Monitoring

(Continued)

ZONE 3	1	1	1	15		5		7		1				30	32	638
2		4	3			12								19	29	446
3		13				7		1						21	21	680
4		2	8			8								18	24	510
5	5		6	7		1			1	3				23	31	505
6		3	6	1		3				3				16	28	389
7	2	13	5	2		5								27	31	592
8	5	3	4	1		21		1	2					37	39	645
9			5			3		1			1			10	20	340
10		2	5	1		4		2	1					15	28	364
11			9					2						11	19	394
17	1	14	1		1	8				1				26	29	610
18		4	1	19		7				4				35	35	680
19		3		9		5		2		1				20	32	425
20	2	7	3	4		3		1			1			21	25	571
21	4	4	6			15				1				30	34	600
22	4	2	3	2		9								20	34	400
25	3	6		7	1	2		1	1		1			22	23	650
27	3	3	3	3		2		4						18	25	490
28		1		1	3	2		1	4					12	22	371
30	1	3		3		3		10	1					21	27	529
34	1	4	1	7		1		4						18	36	340
35		2	9	12		1		1						25	27	630
36		11		8		14				2		1		36	42	583
37	5		4	4	2	22								37	37	680
38		5	5	8		8				1				27	30	612
39	5	4	1			5			3					18	22	556
40		7		12		1						2		22	30	499
41	3	3	11	1		2		7		1				28	30	635
48	5	5	2	11	1					1				25	30	567
ZONE 3 AVERAGE DENSITY																531

ZONE 4	44					24	11						2		37	40	629
45				6		15	5		4					30	36	567	
46				4		19	2		2				1		28	39	488

ZONE 4 AVERAGE DENSITY **561**

TOTAL AVERAGE DENSITY **552**

To determine tree density, 50' x 50' plots are installed immediately following planting. The actual number of planted trees which occur within the plot are counted. This number is equated to the number within each plot, which represents 680 trees per acre (average). The survival monitoring number is compared to the planted number to obtain survival percentage. This percentage is applied to the 680 trees per acre to obtain an estimated tree per acre for the site. (Density = monitoring count / planted trees x 680)

Site Notes:

Zone 1: Other species noted: broomsedge, goldenrod, volunteer pine, red maple, foxtail, giant foxtail, holly, fennel, juncus and sweetgum. Evidence of standing water in plot 43. Some deer grazing noted.

Zone 2: Other species noted: broomsedge, goldenrod, volunteer pine (some pond pine) and sicklepod. Some deer grazing noted.

Zone 3: Other species noted: broomsedge, red maple, volunteer pine (some pond pine) foxtail, giant foxtail, pokeberry, wild onion, switch grass, baccharis, panicum, giant cane, goldenrod, horse fennel, woolgrass, juncus, sweet gum and aster. Broomsedge is throughout zone. There was evidence of standing water in plots 2 and 3 and plot 34 was saturated.

Zone 4: Other species noted: foxtail and some broomsedge. Evidence of standing water in all zone 4 plots. Few herbaceous species are in this zone.

3.4 Conclusions

Of the 612 acres on this site, approximately 576 involve tree planting. There were 48 plots established throughout the planting areas, encompassing all plant communities. The vegetation monitoring resulted in average densities of: zone 1 of 590, zone 2 of 595, zone 3 of 531 and zone 4 of 561 trees per acre, all are well above the success criteria of 320 trees per acre.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

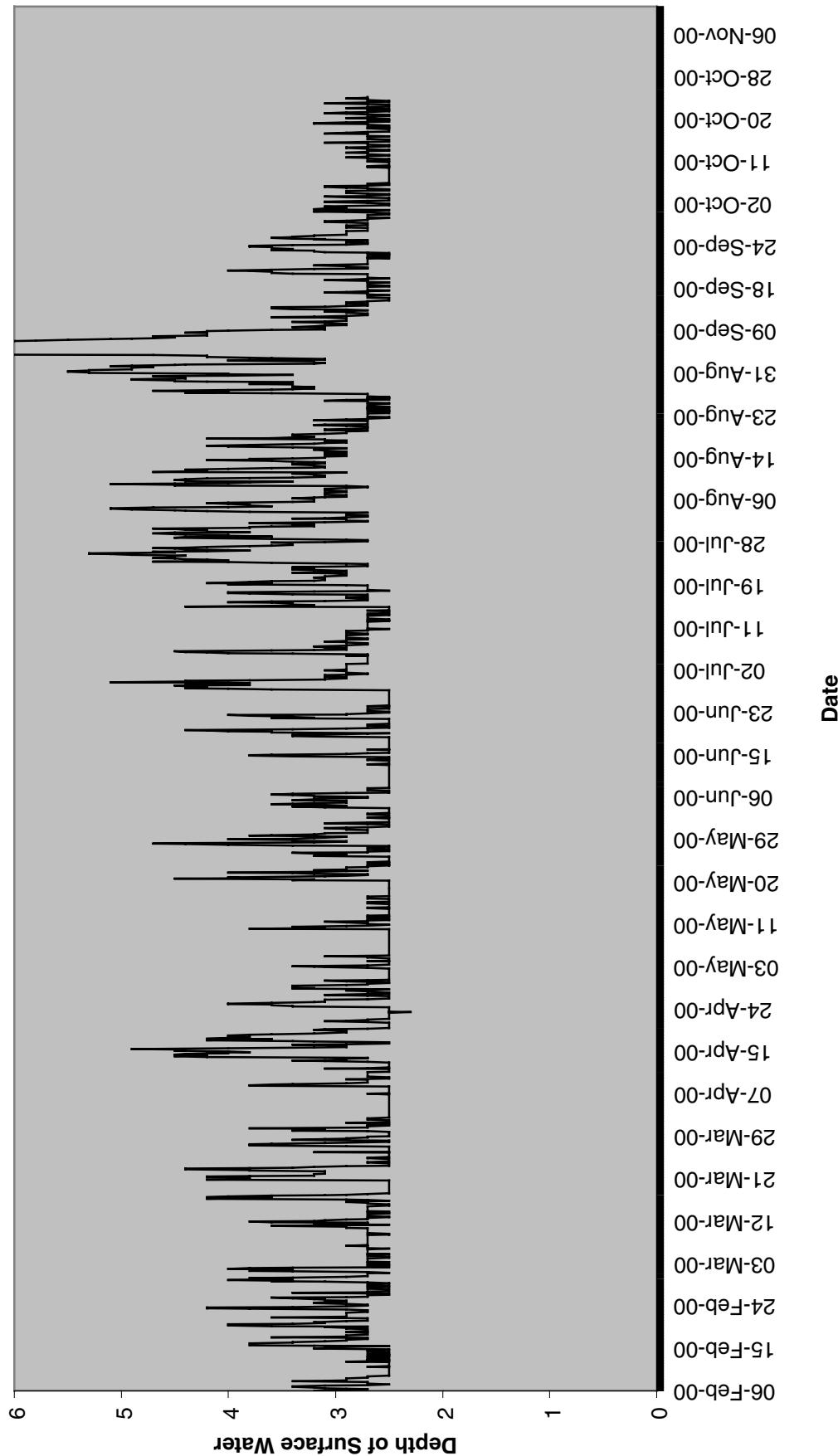
The site has shown considerable improvement in the last year in both hydrology and vegetation. Nineteen of the twenty-six wells met their expected hydrologic criteria during a year of relatively average rainfall. Vegetation Plots located in both phases of the planting show high tree survival.

At this time, NCDOT proposes to continue hydrologic and vegetation monitoring of the site in 2001.

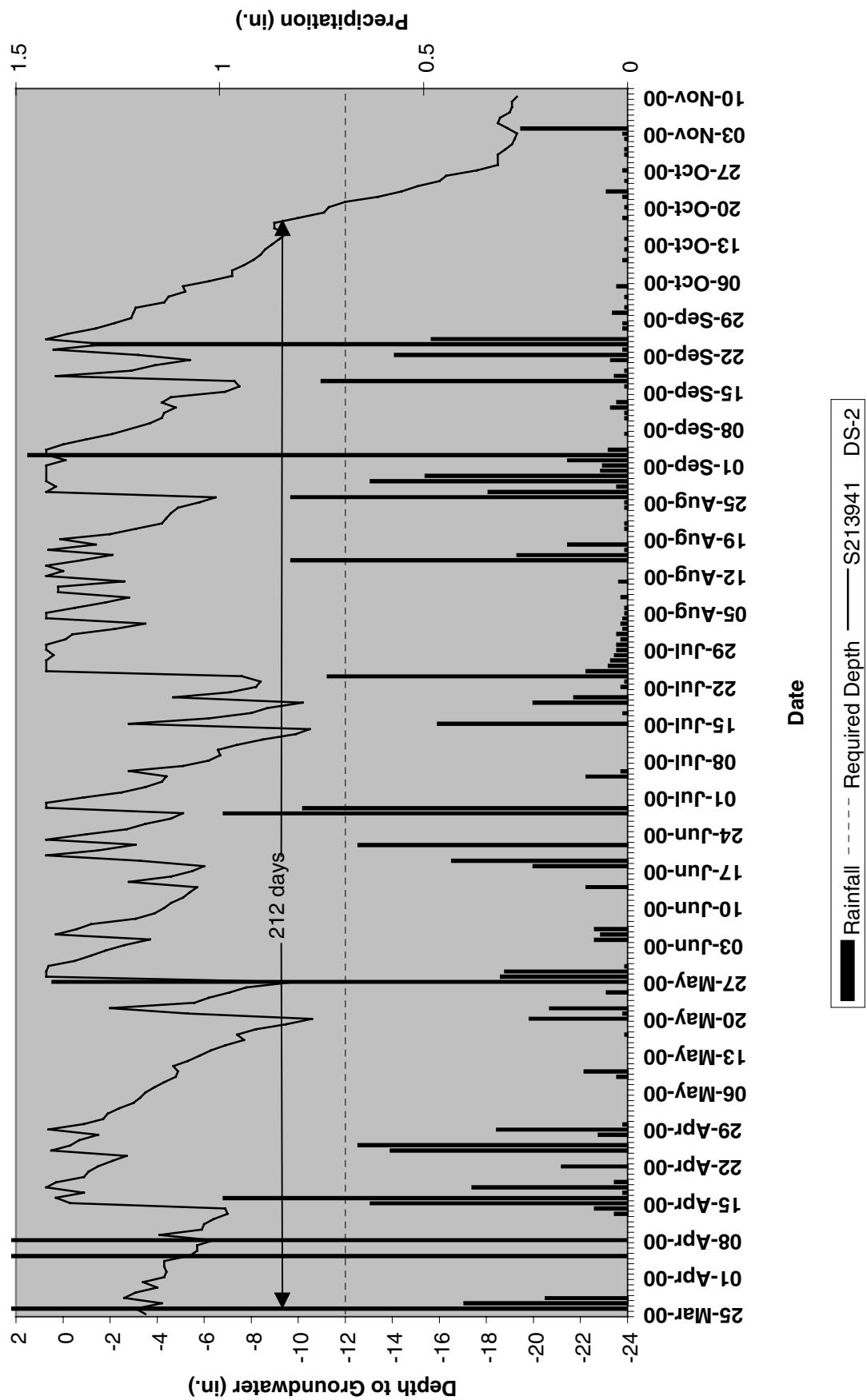
APPENDIX A

DEPTH TO GROUNDWATER PLOTS

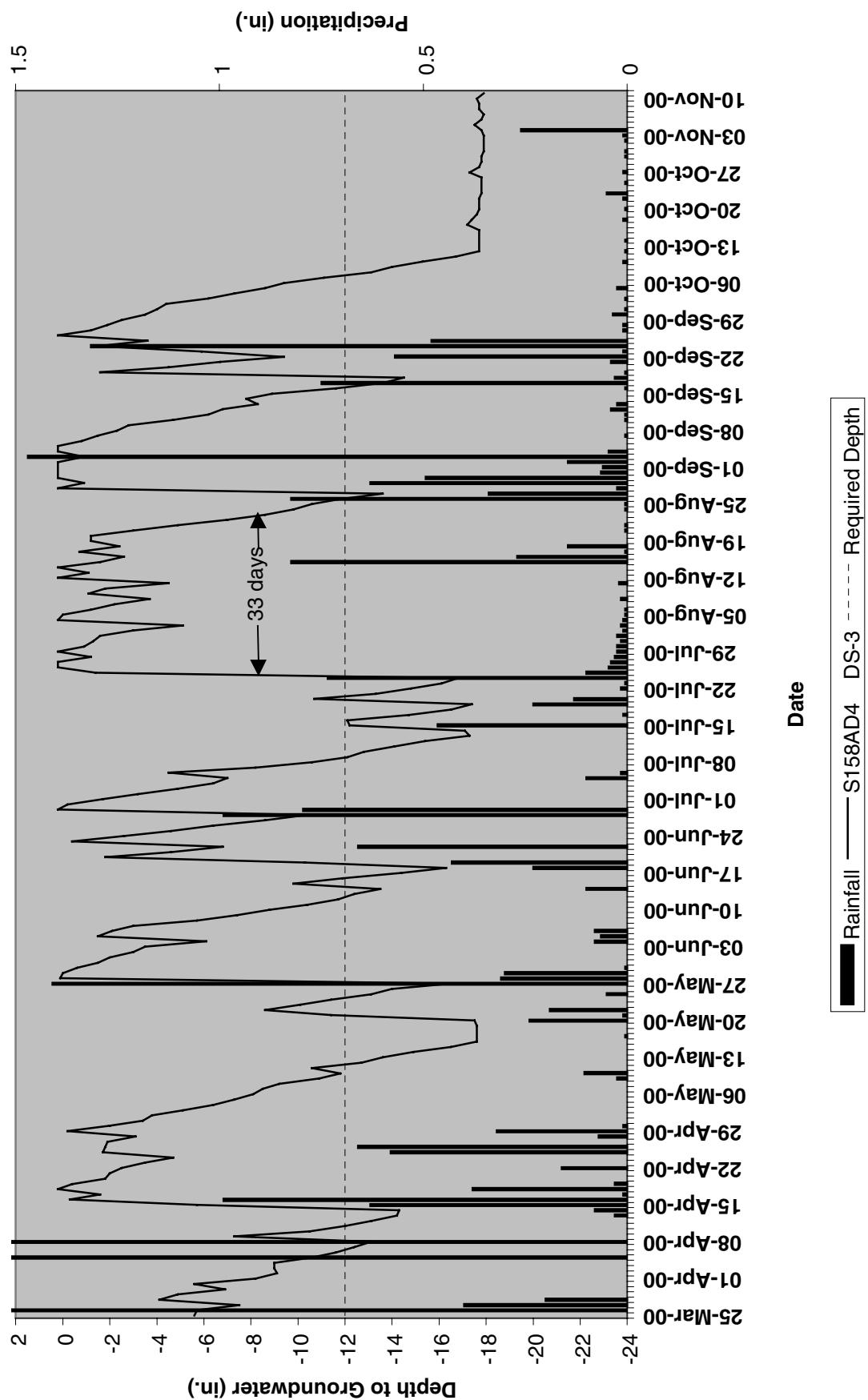
**Dismal Swamp-W1
Surface Gauge**



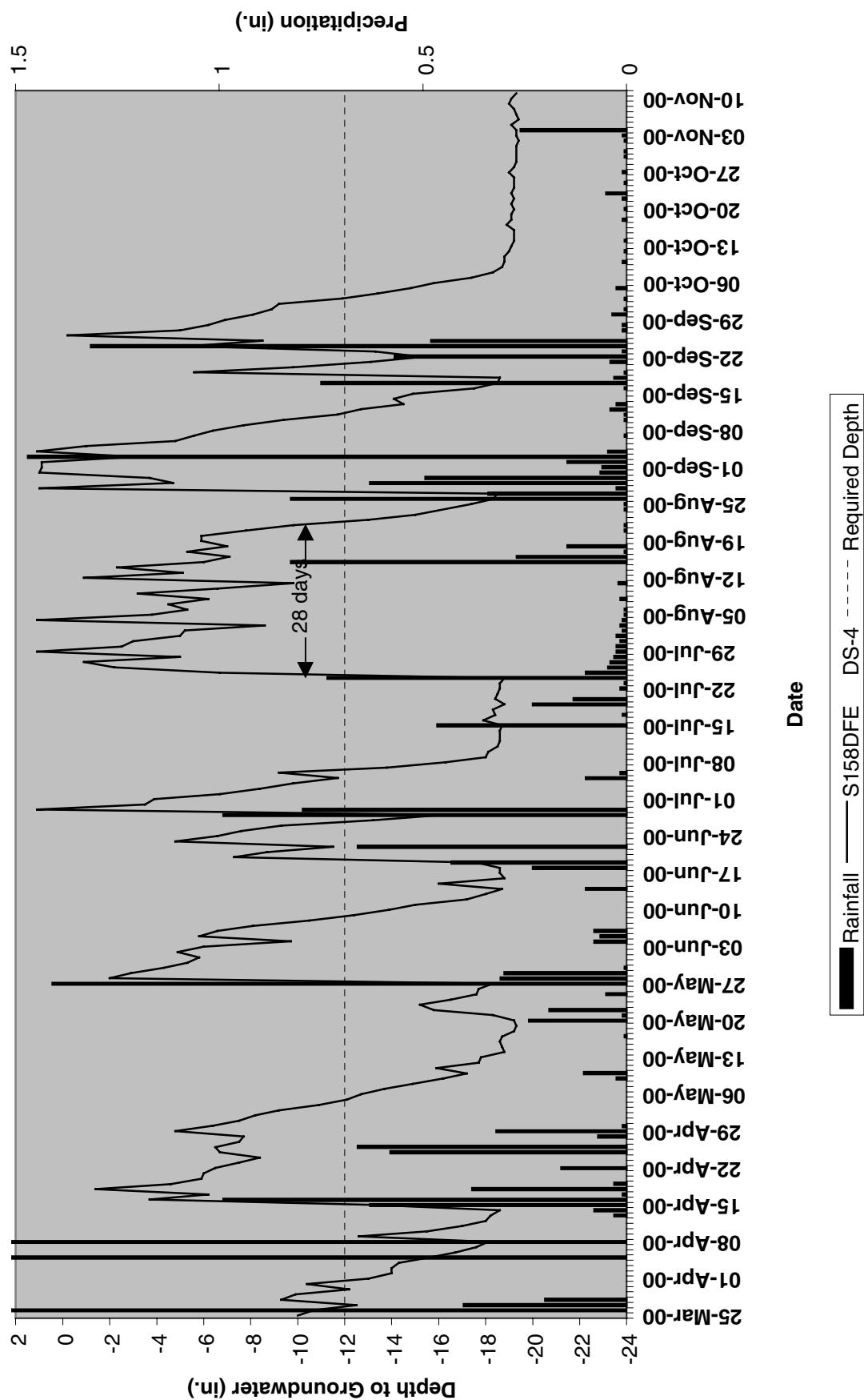
Dismal Swamp-G2



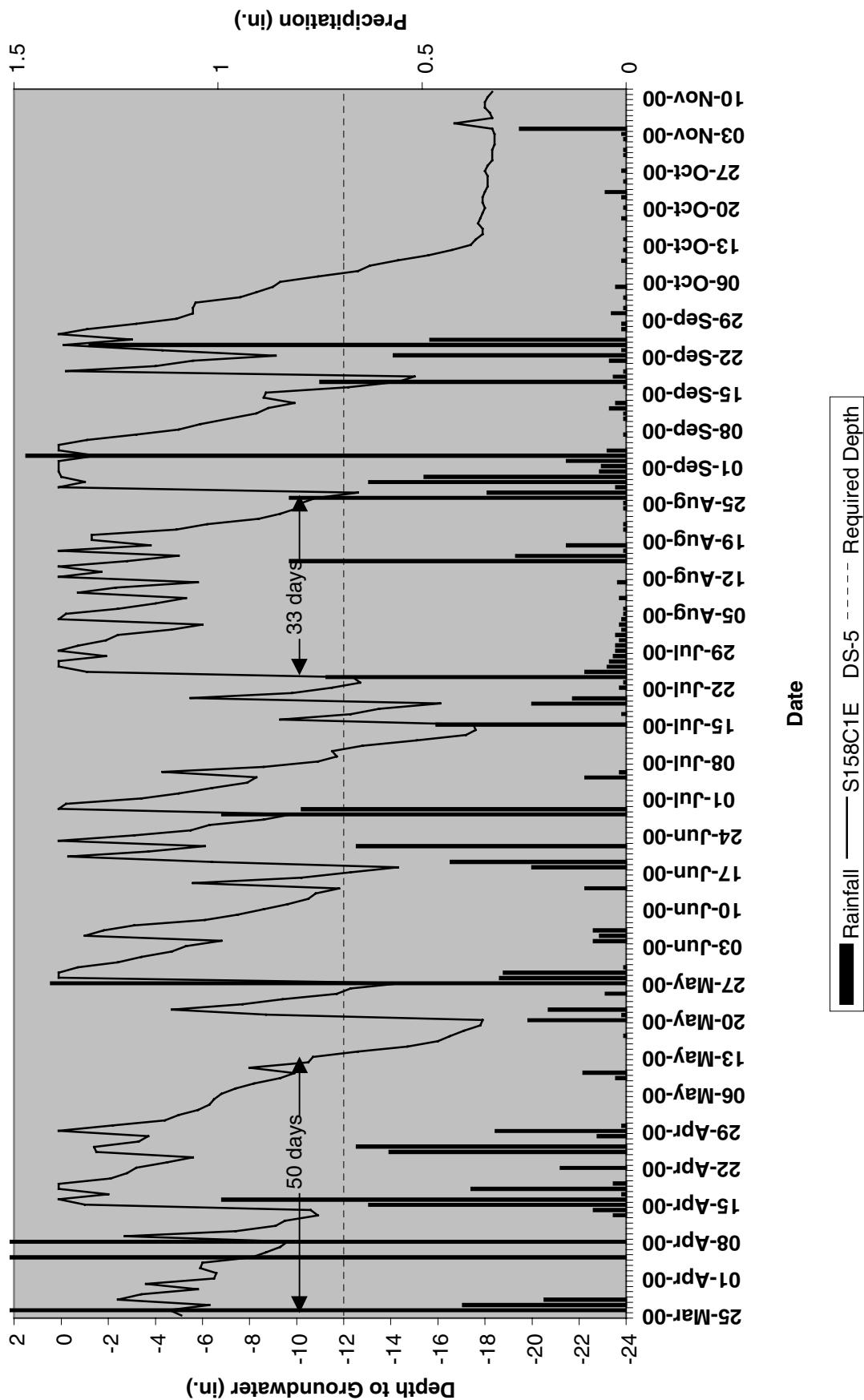
Dismal Swamp-G3



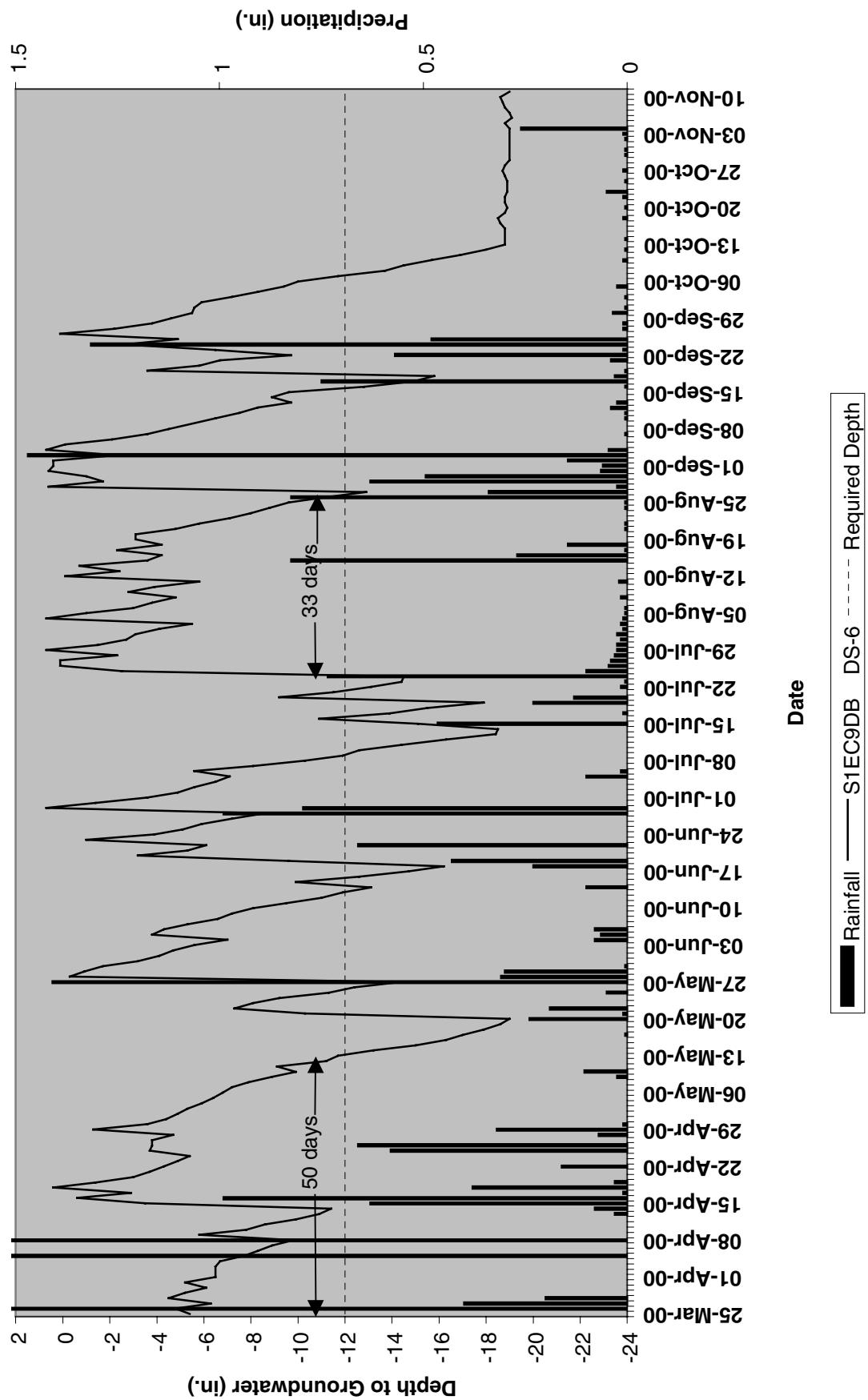
Dismal Swamp-G4



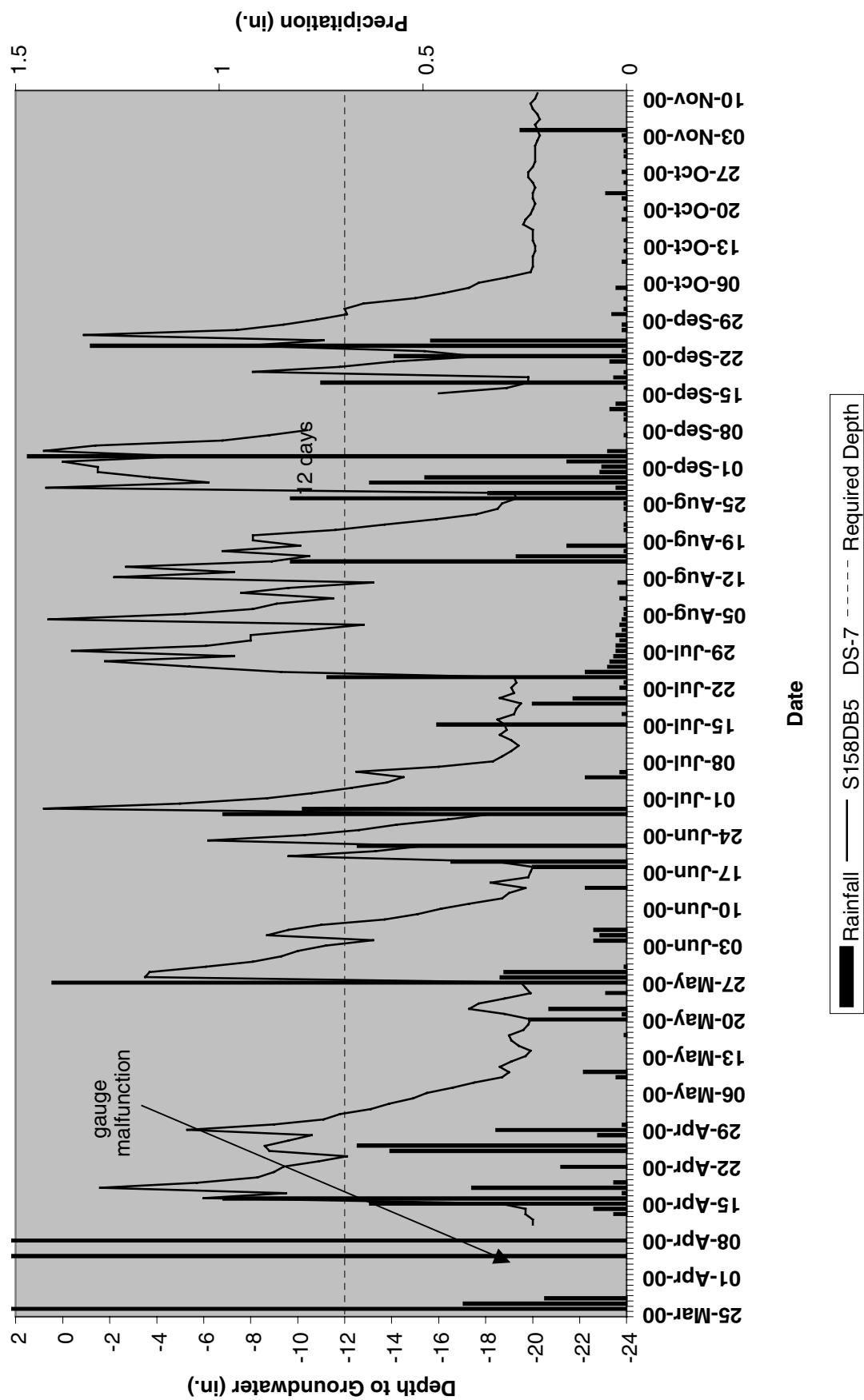
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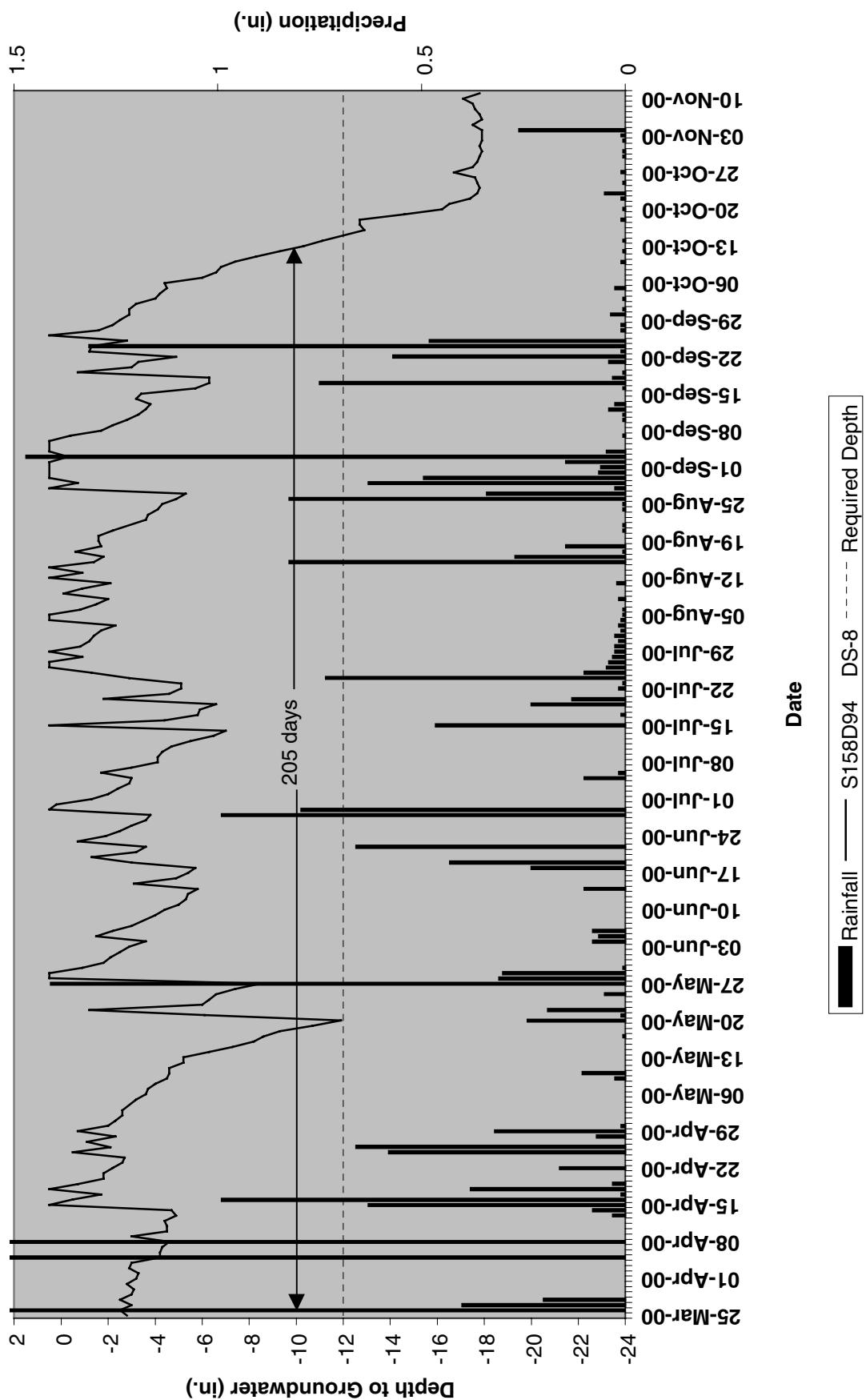
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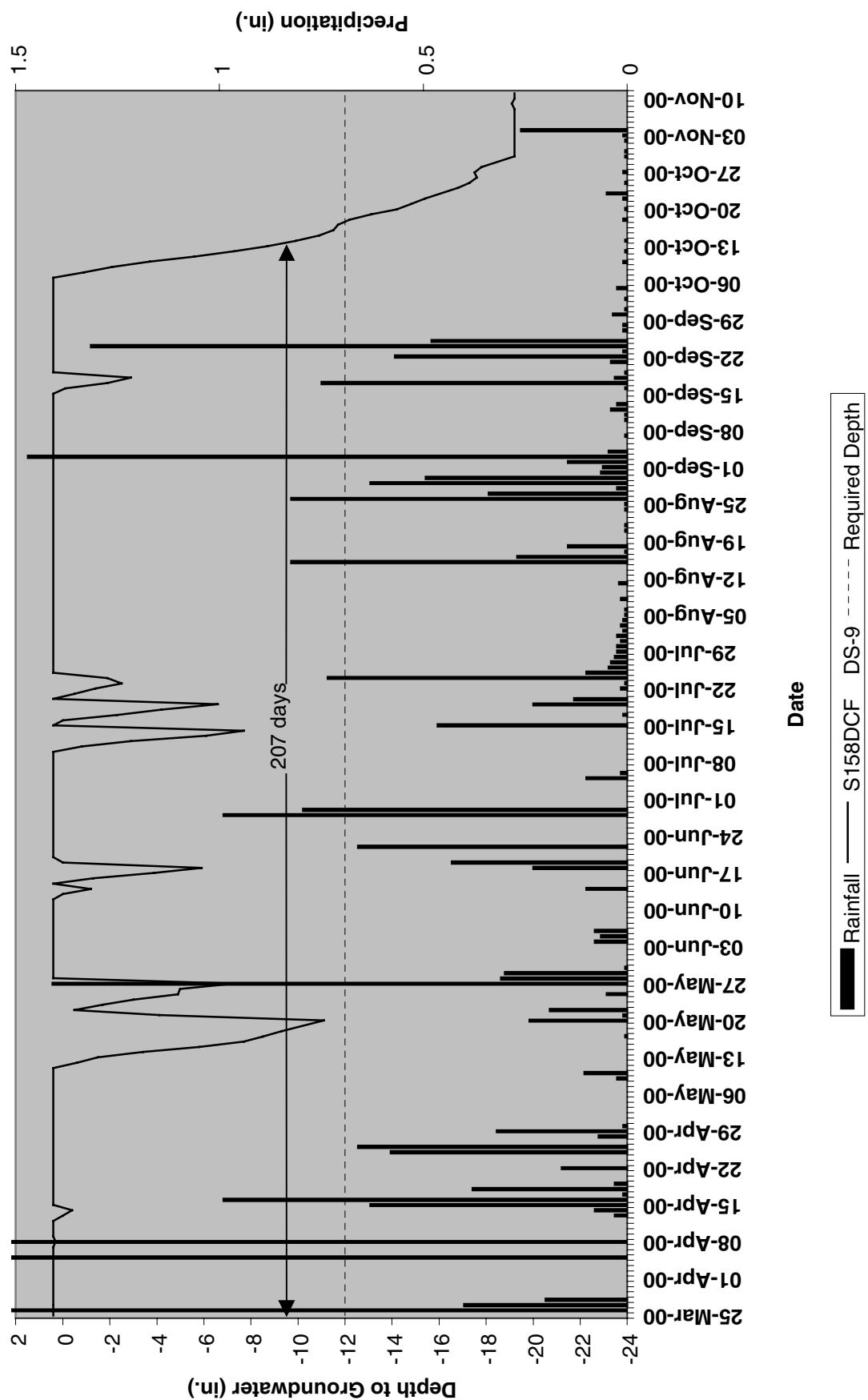
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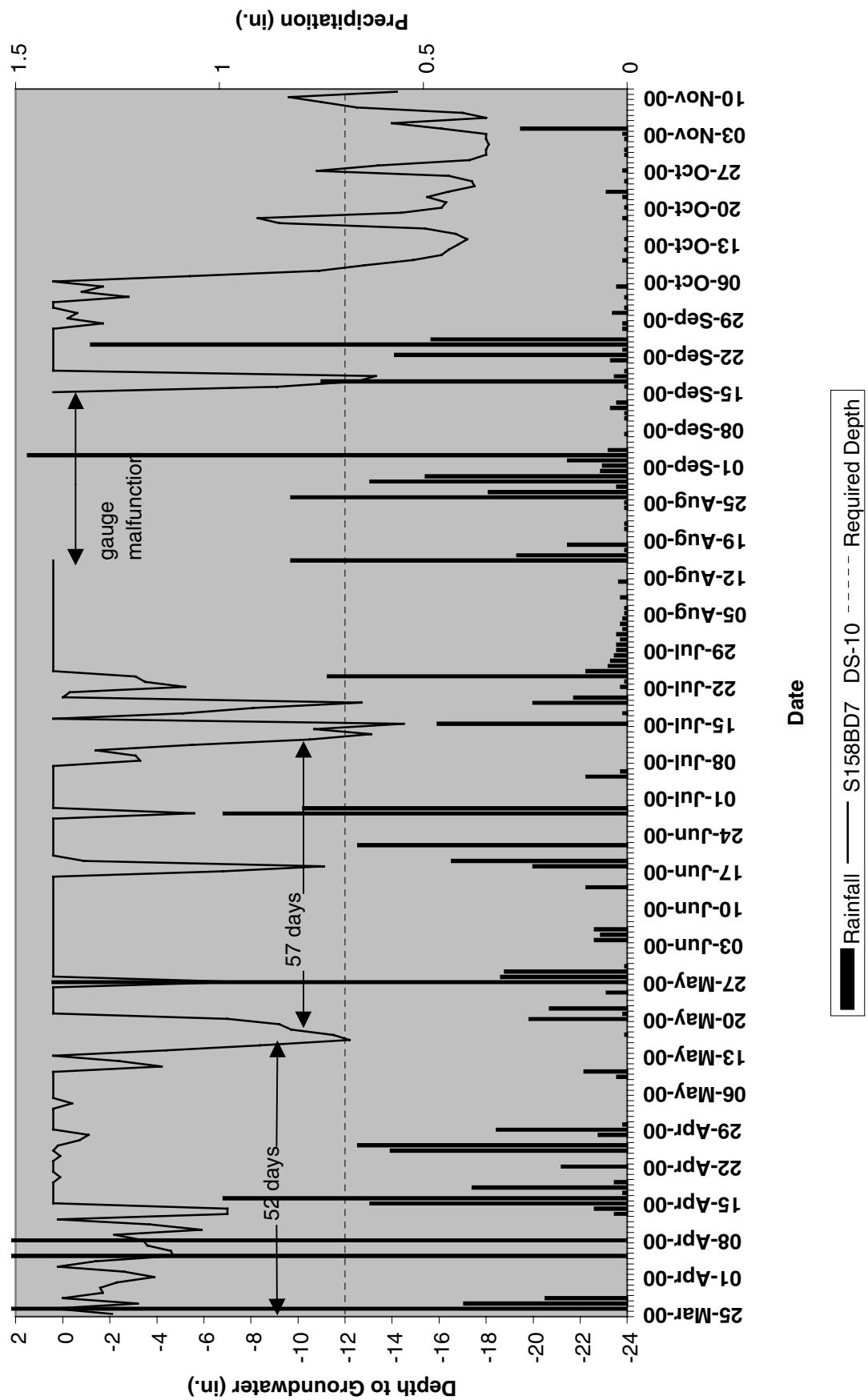
Dismal Swamp-G8



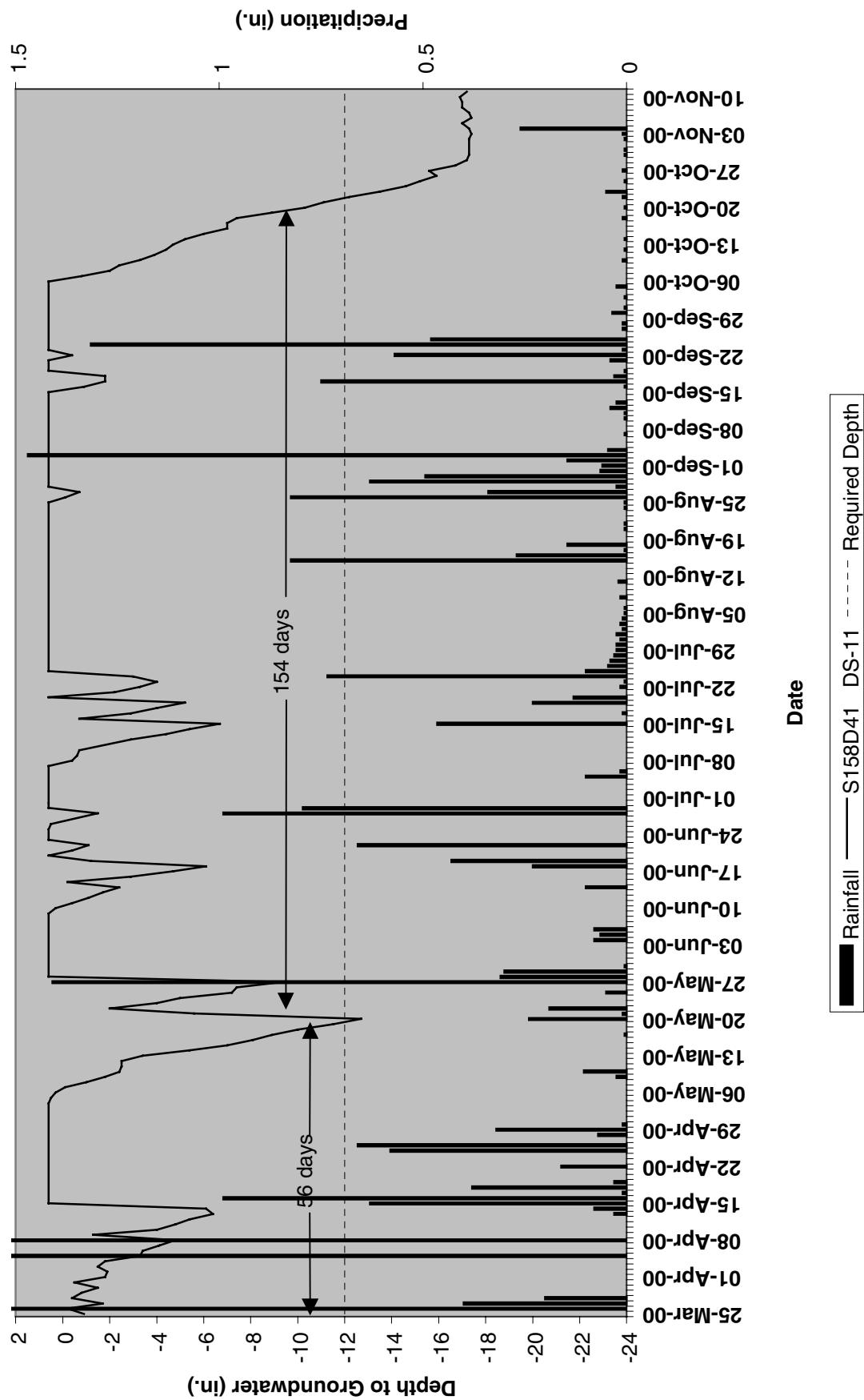
Dismal Swamp-G9



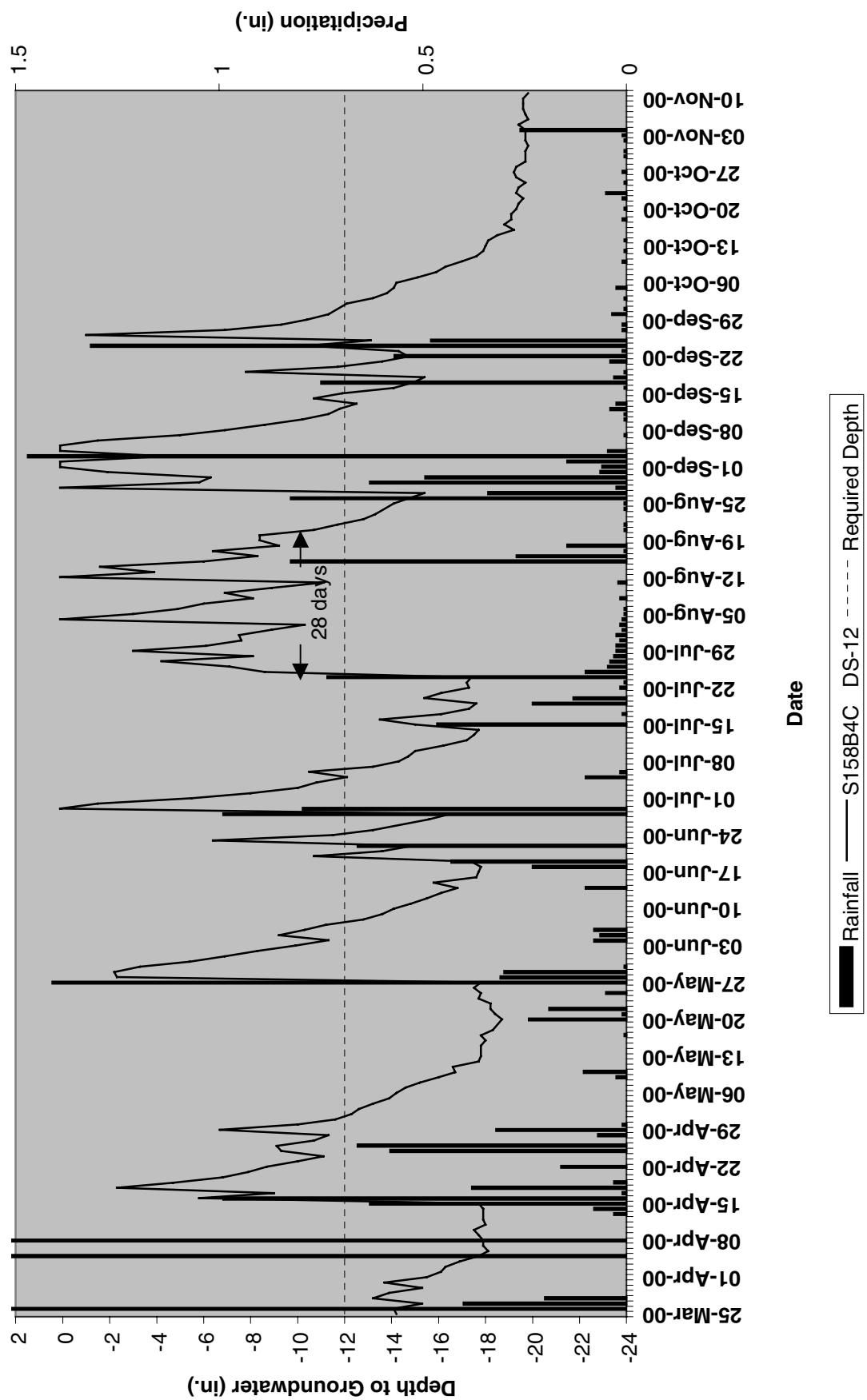
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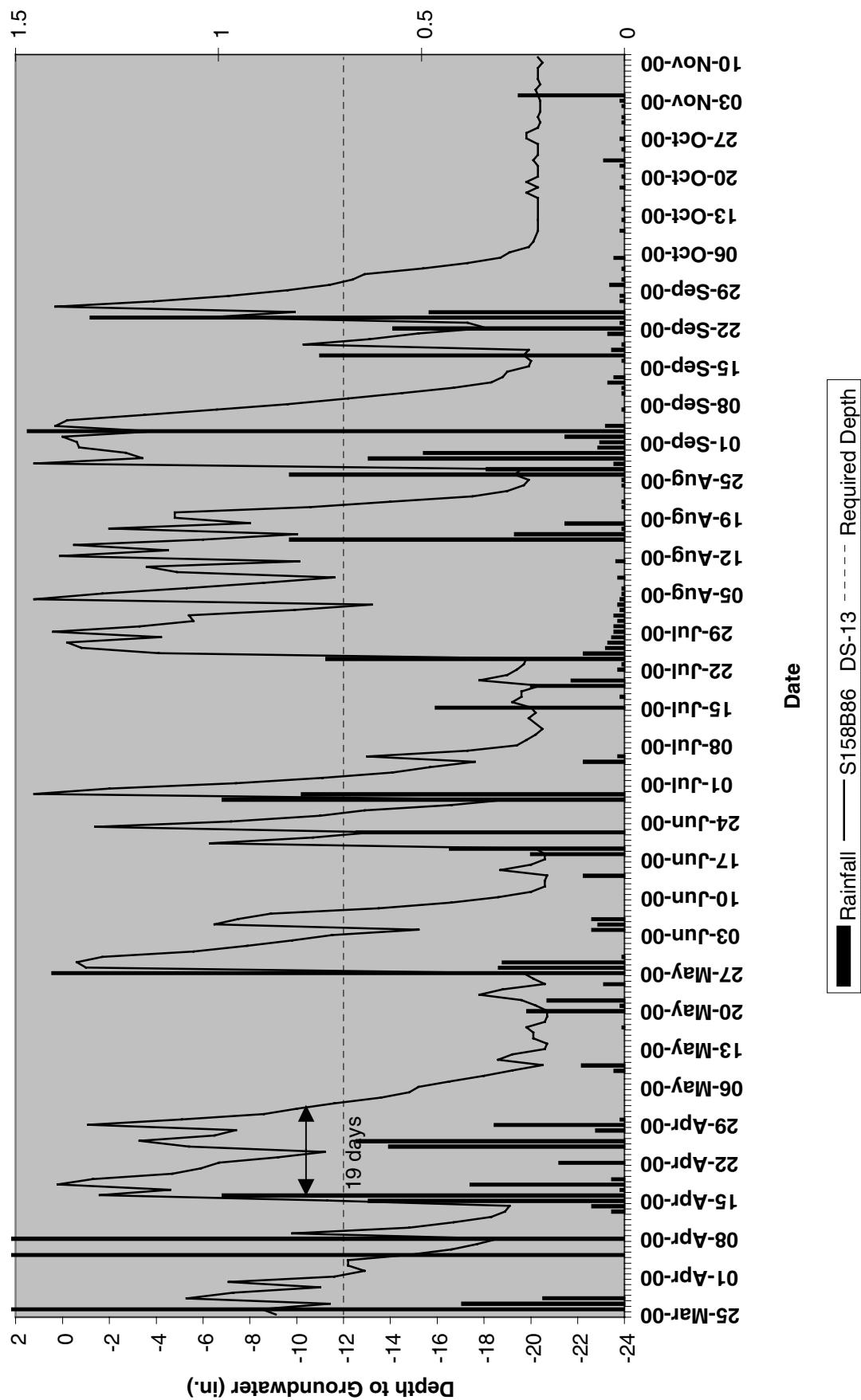
Dismal Swamp-G11



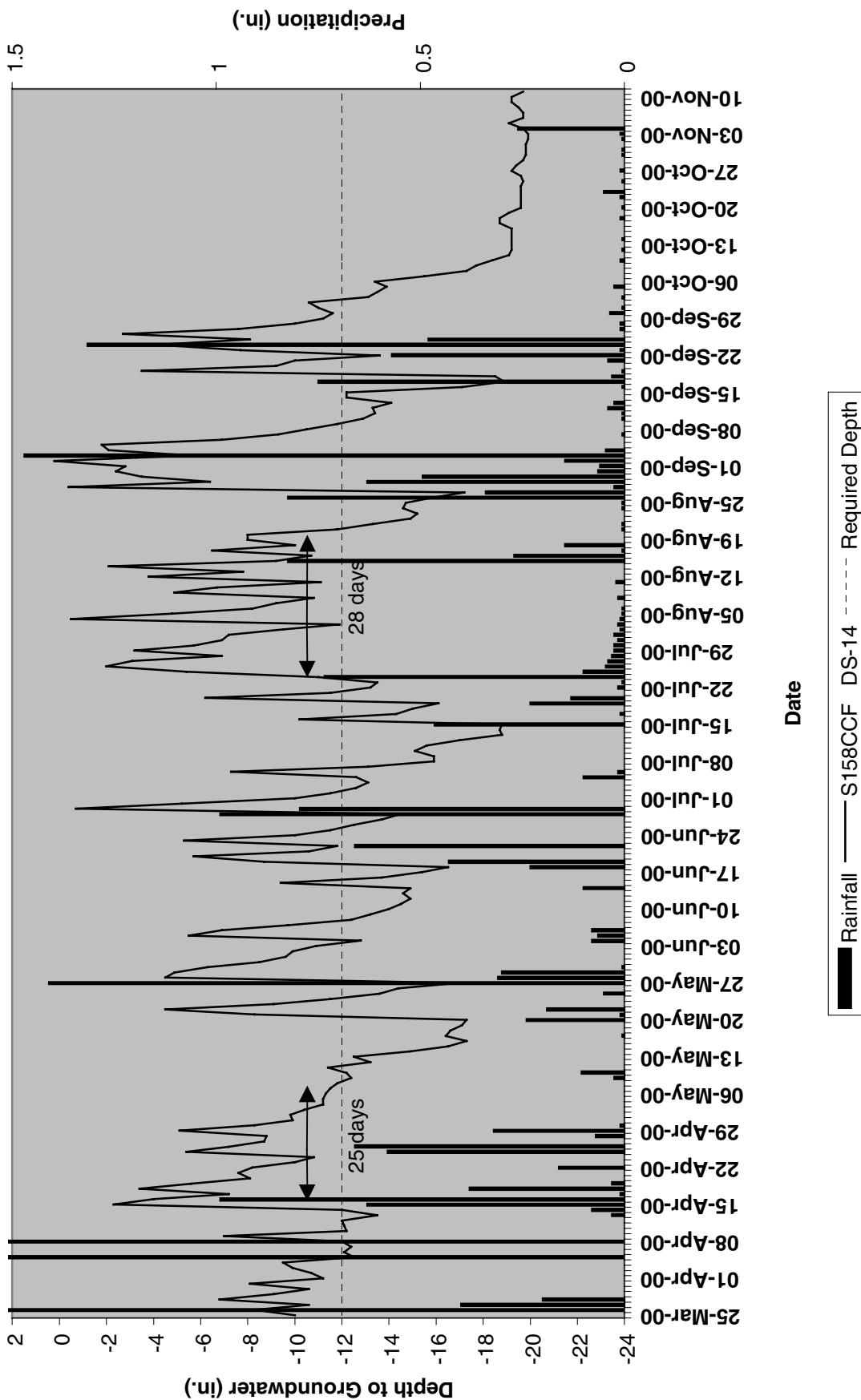
Dismal Swamp-G12

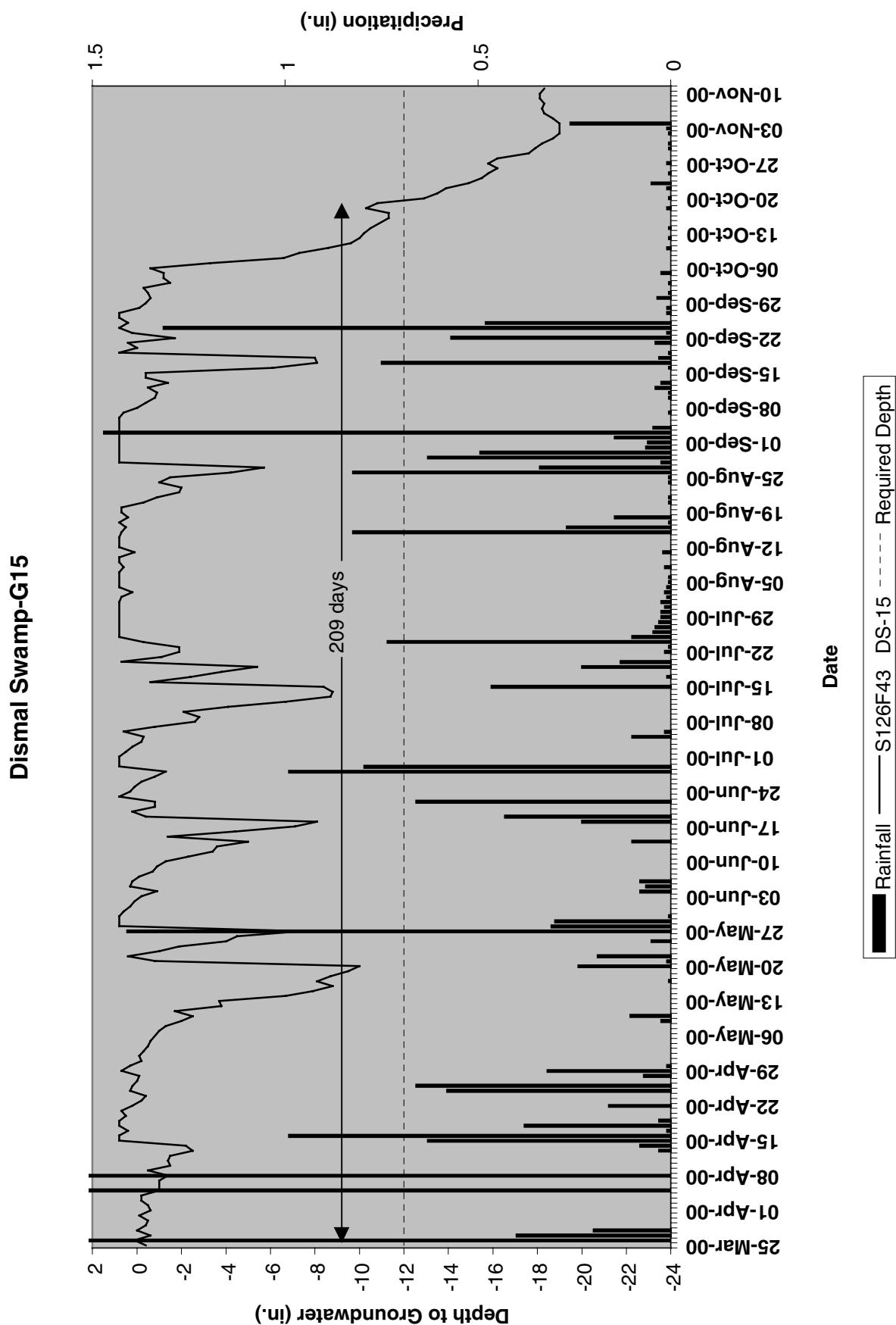


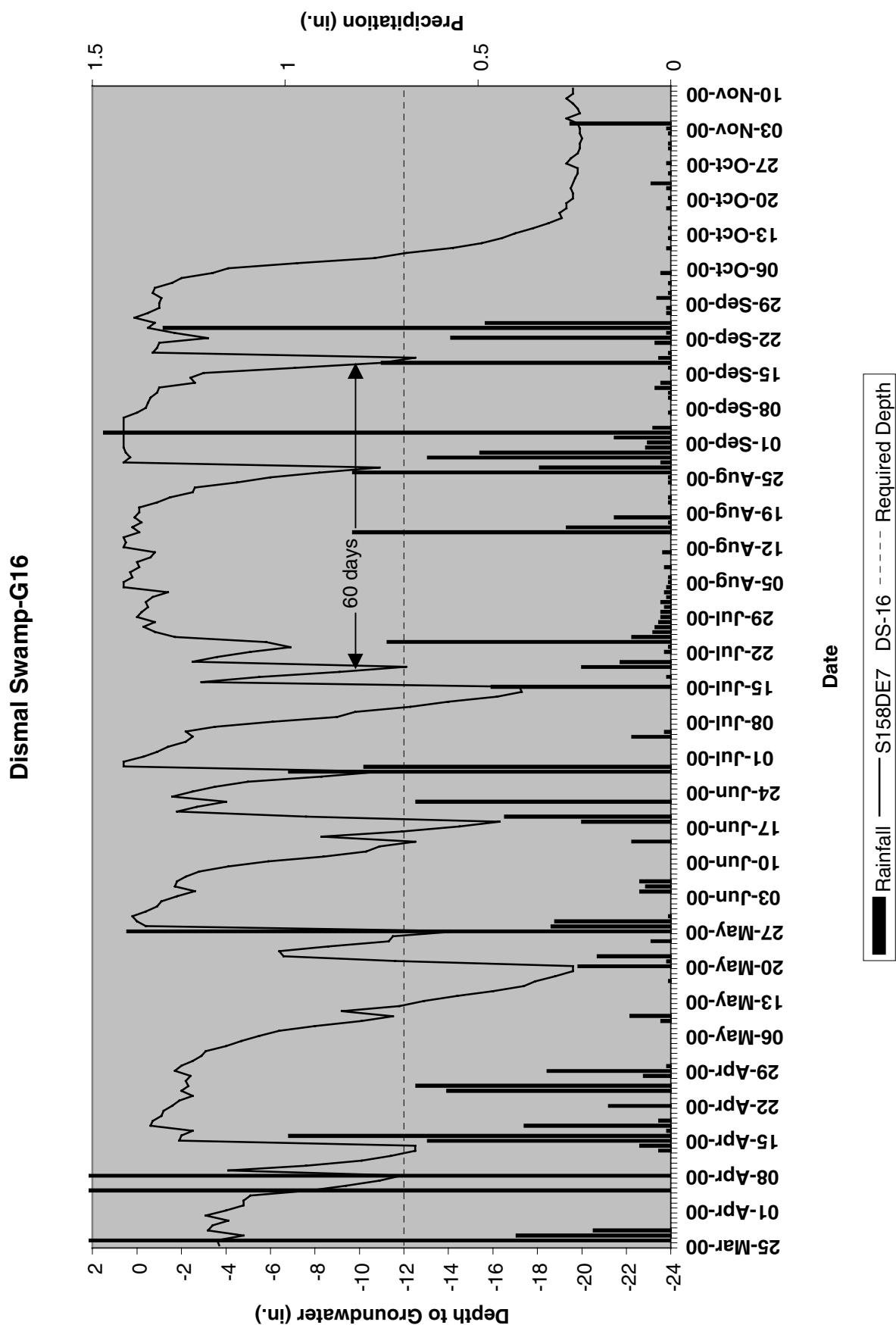
Dismal Swamp-G13



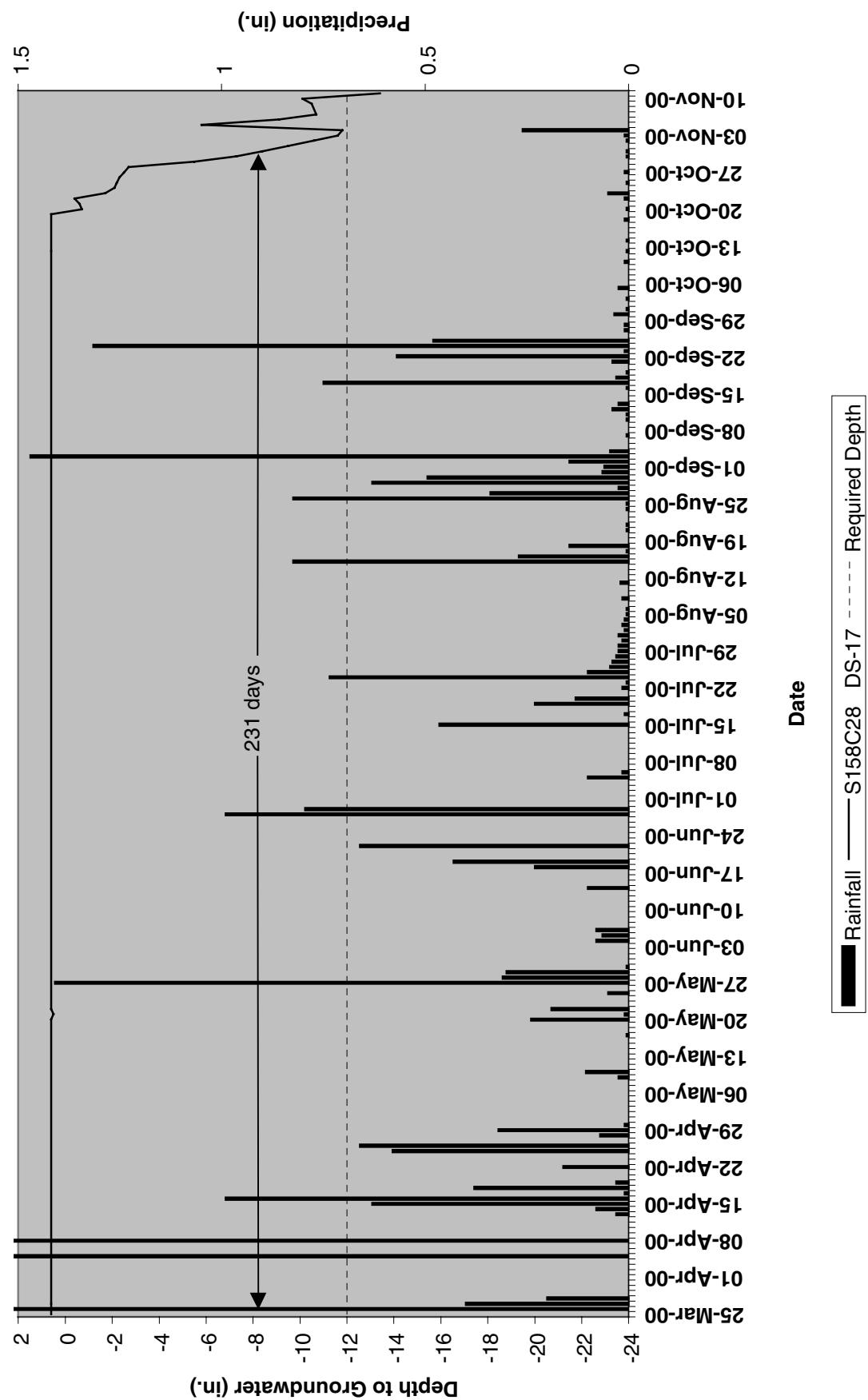
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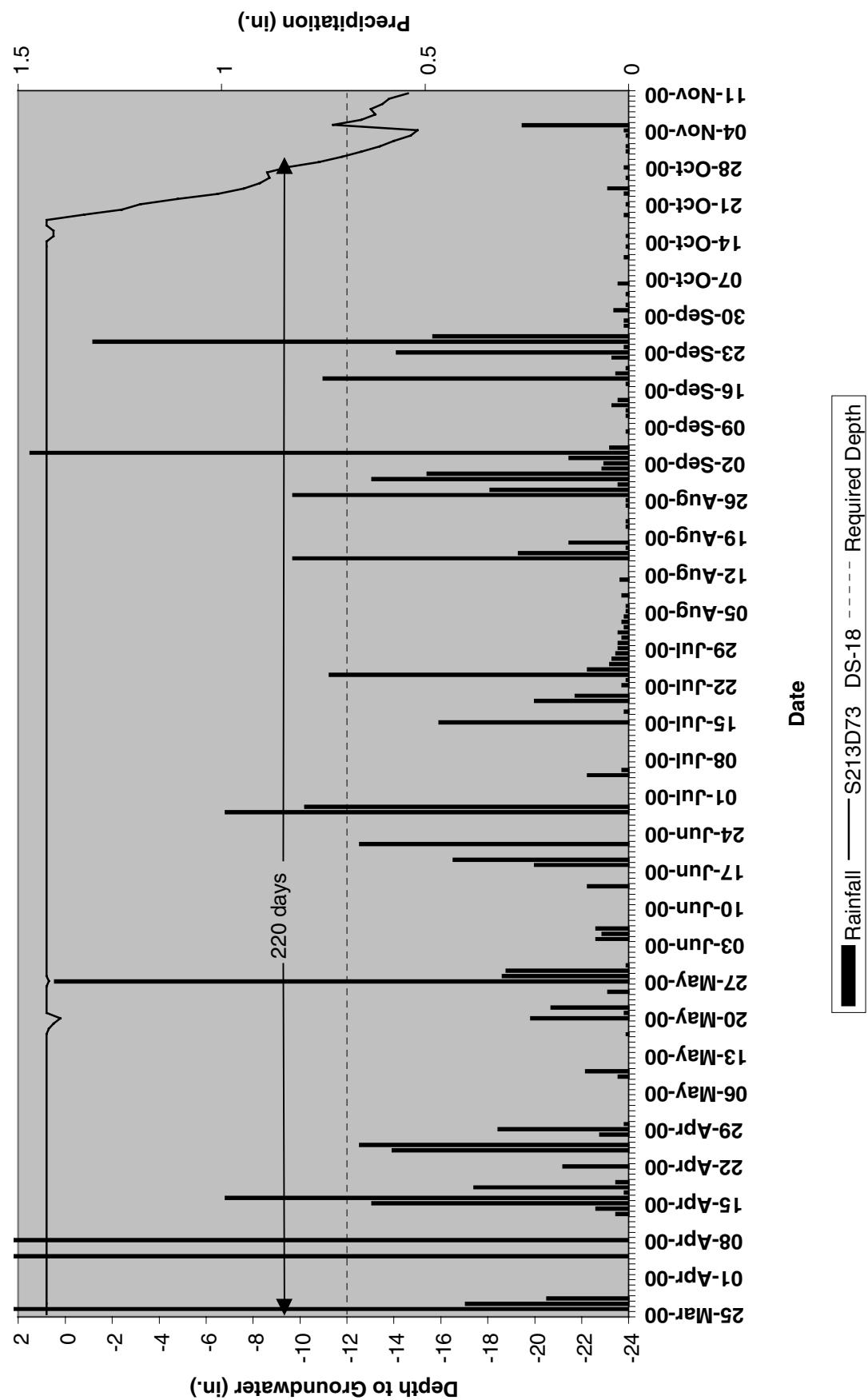




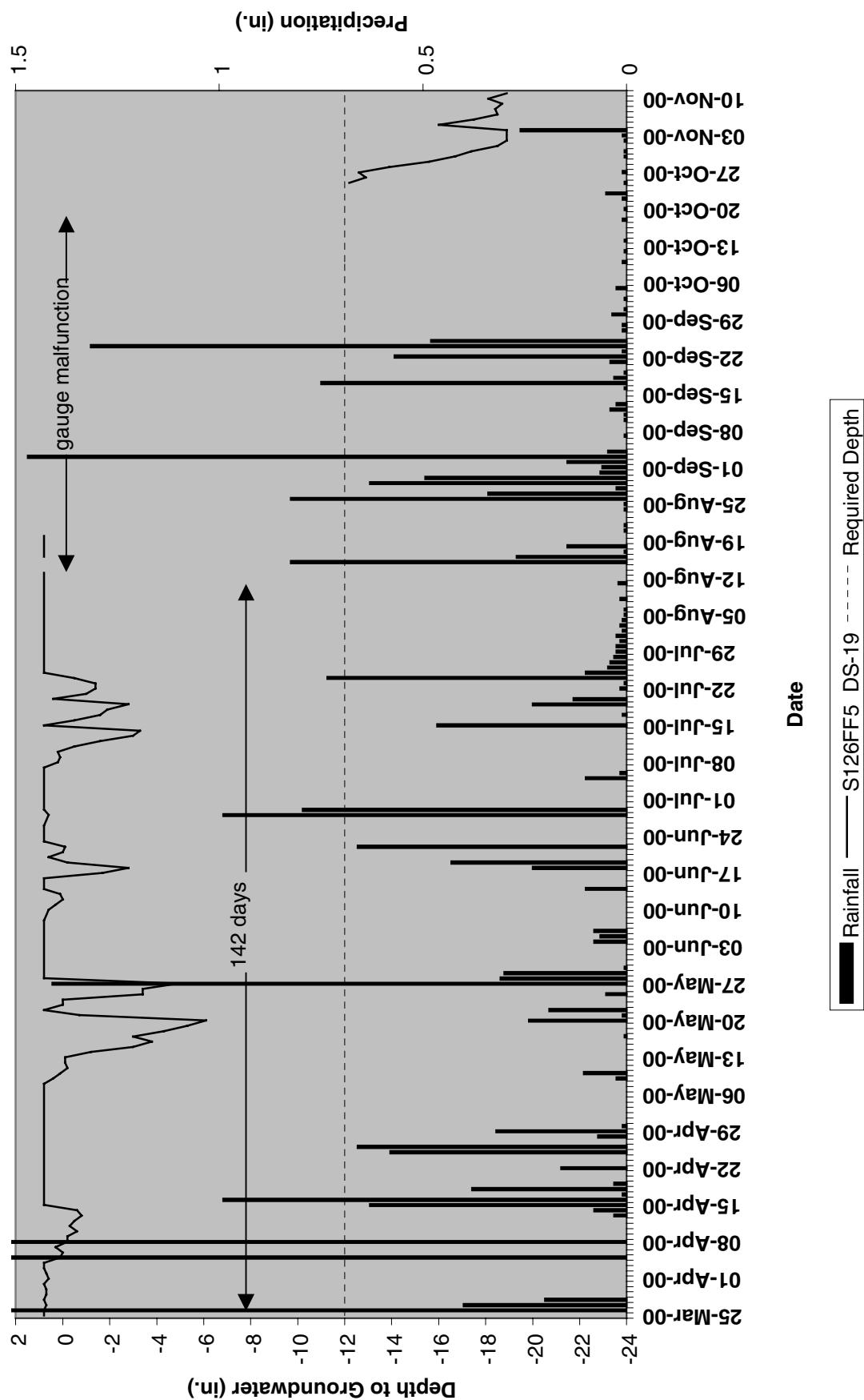
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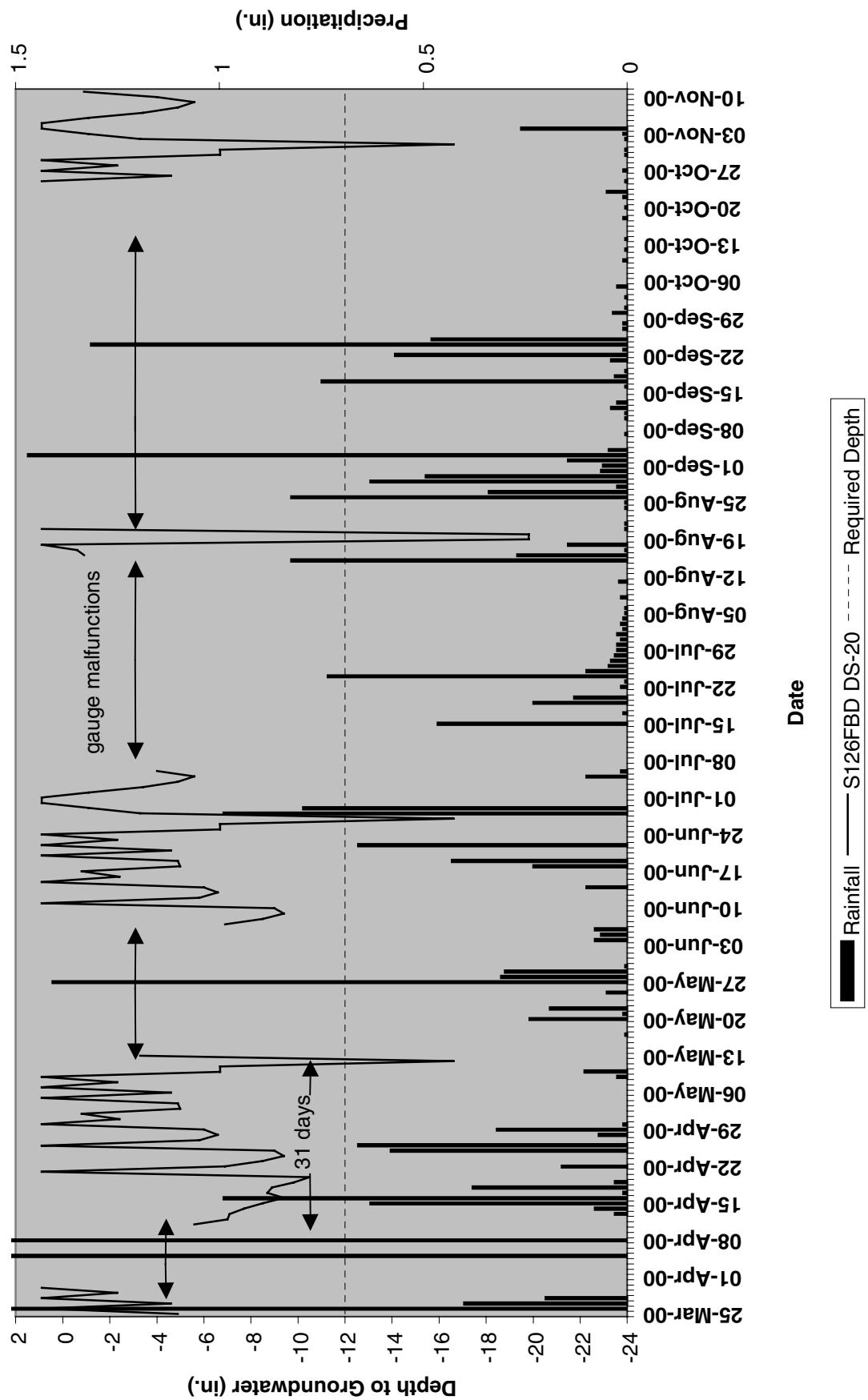
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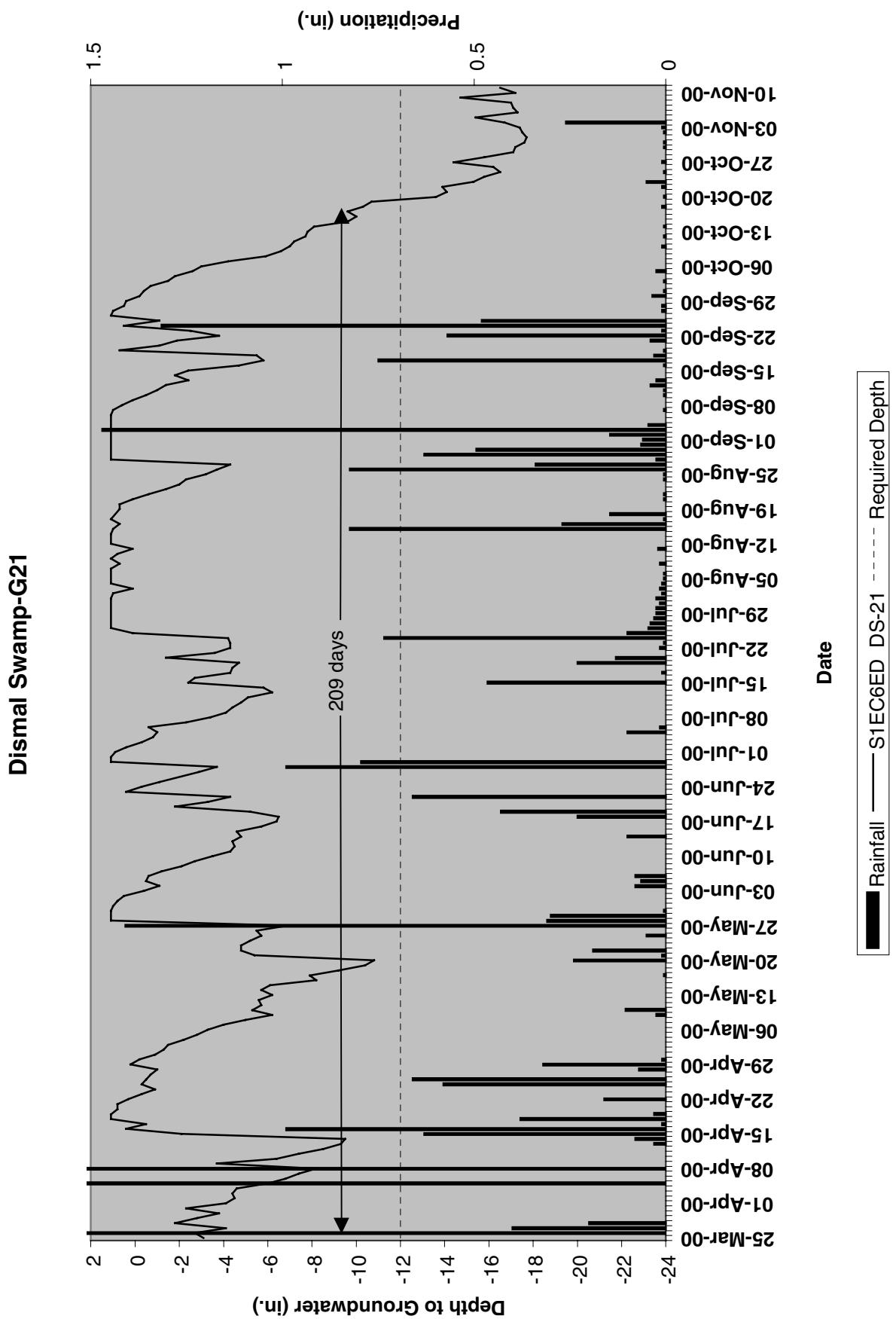


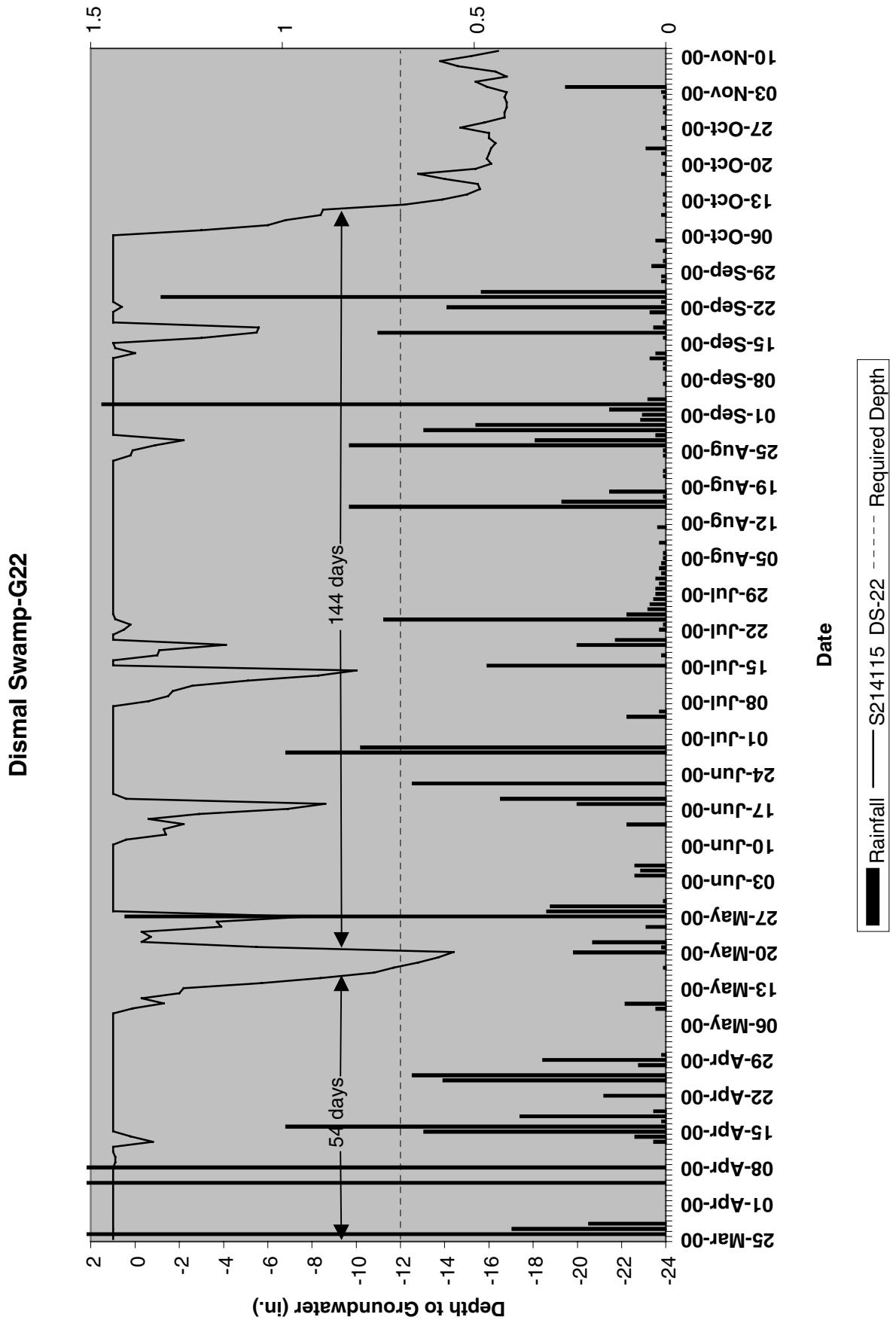
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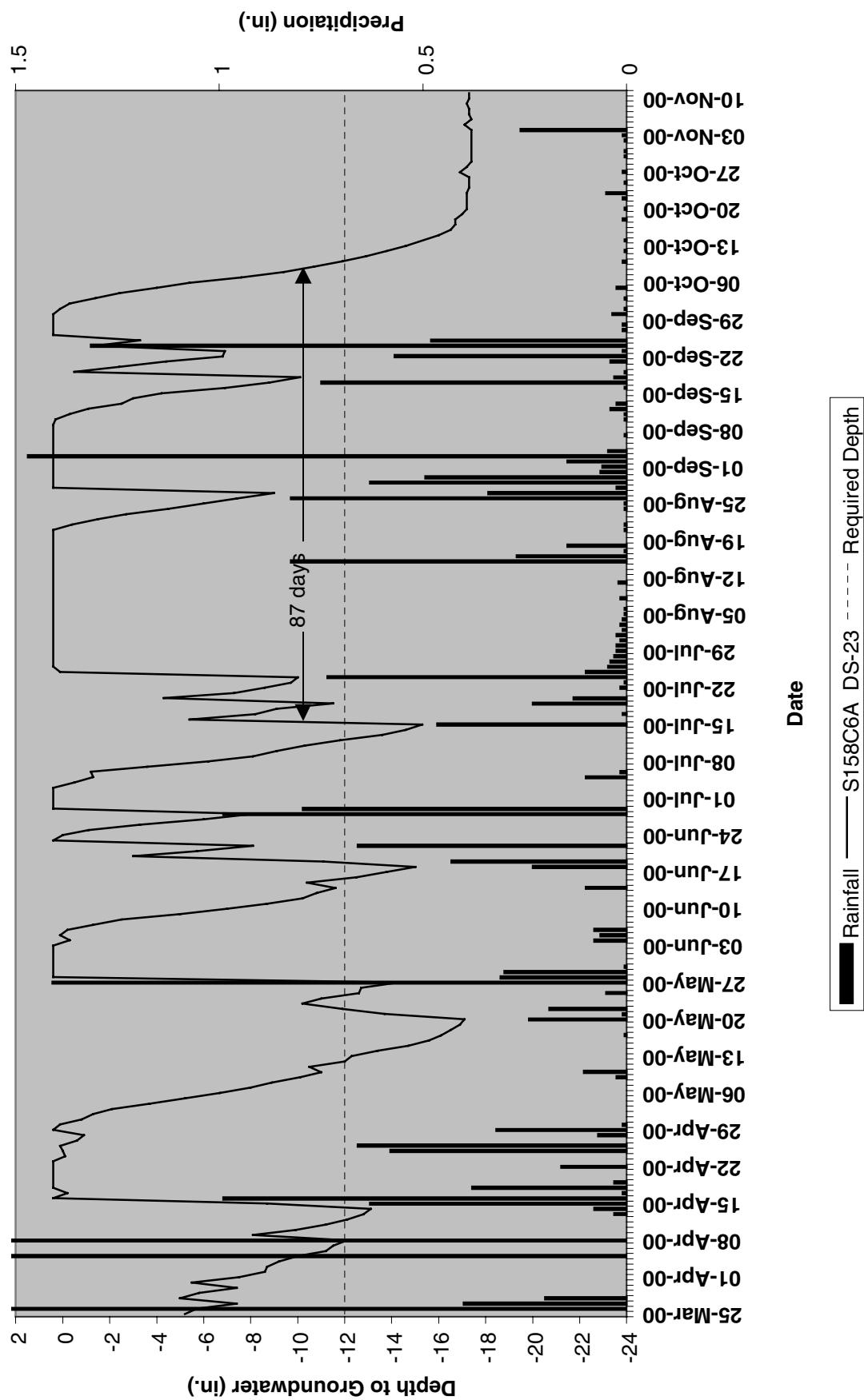
Dismal Swamp-G20



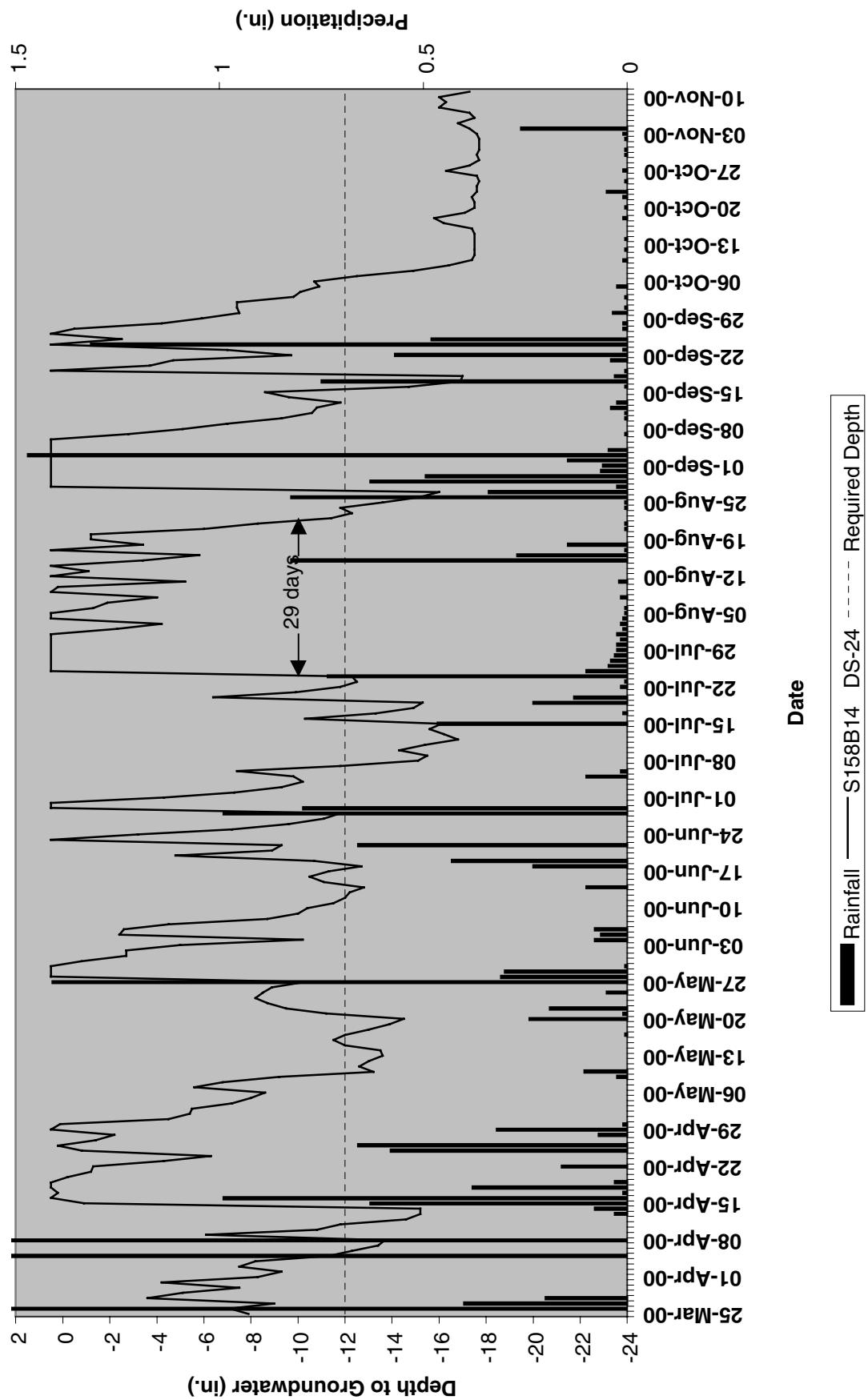




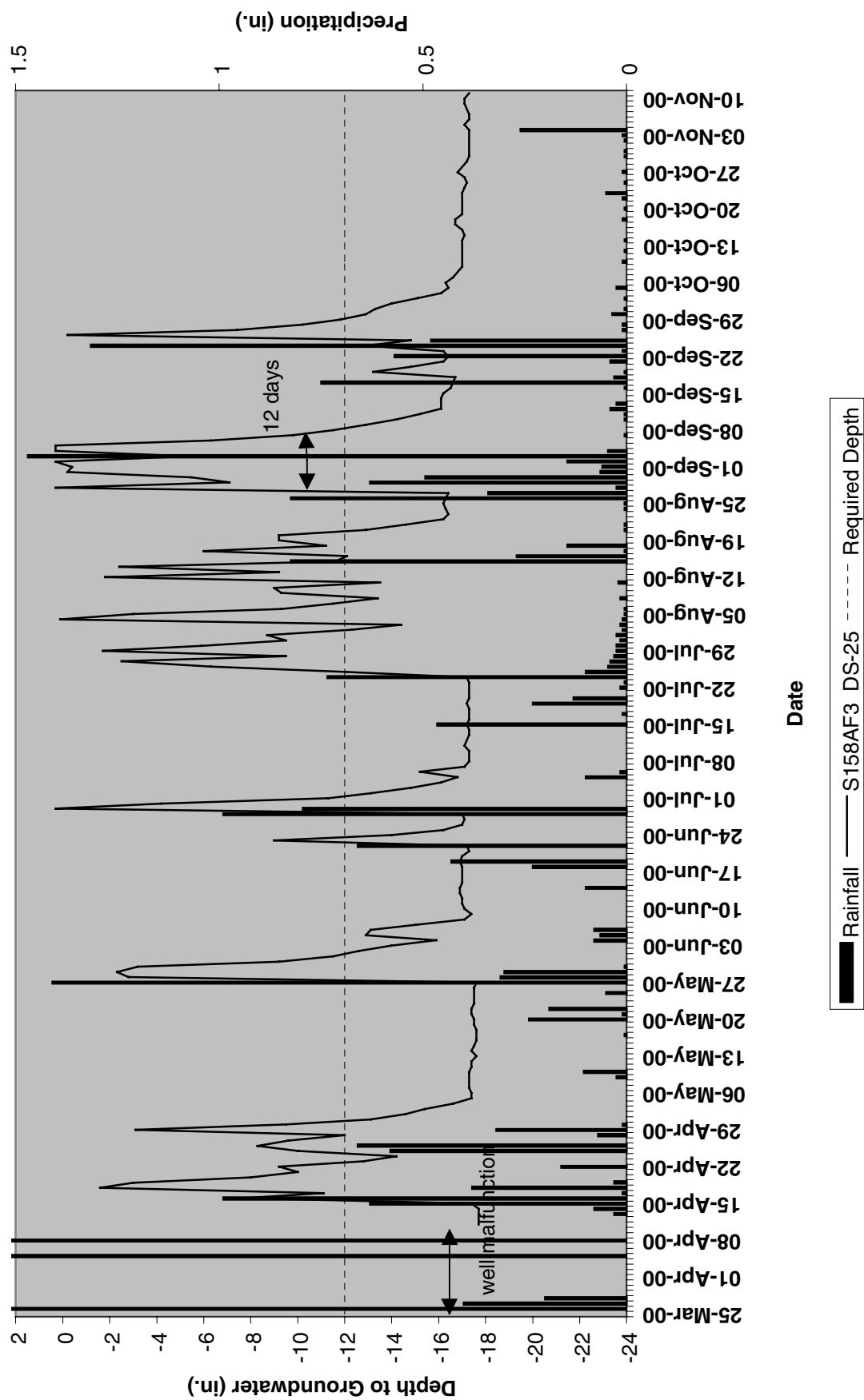
Dismal Swamp-G23



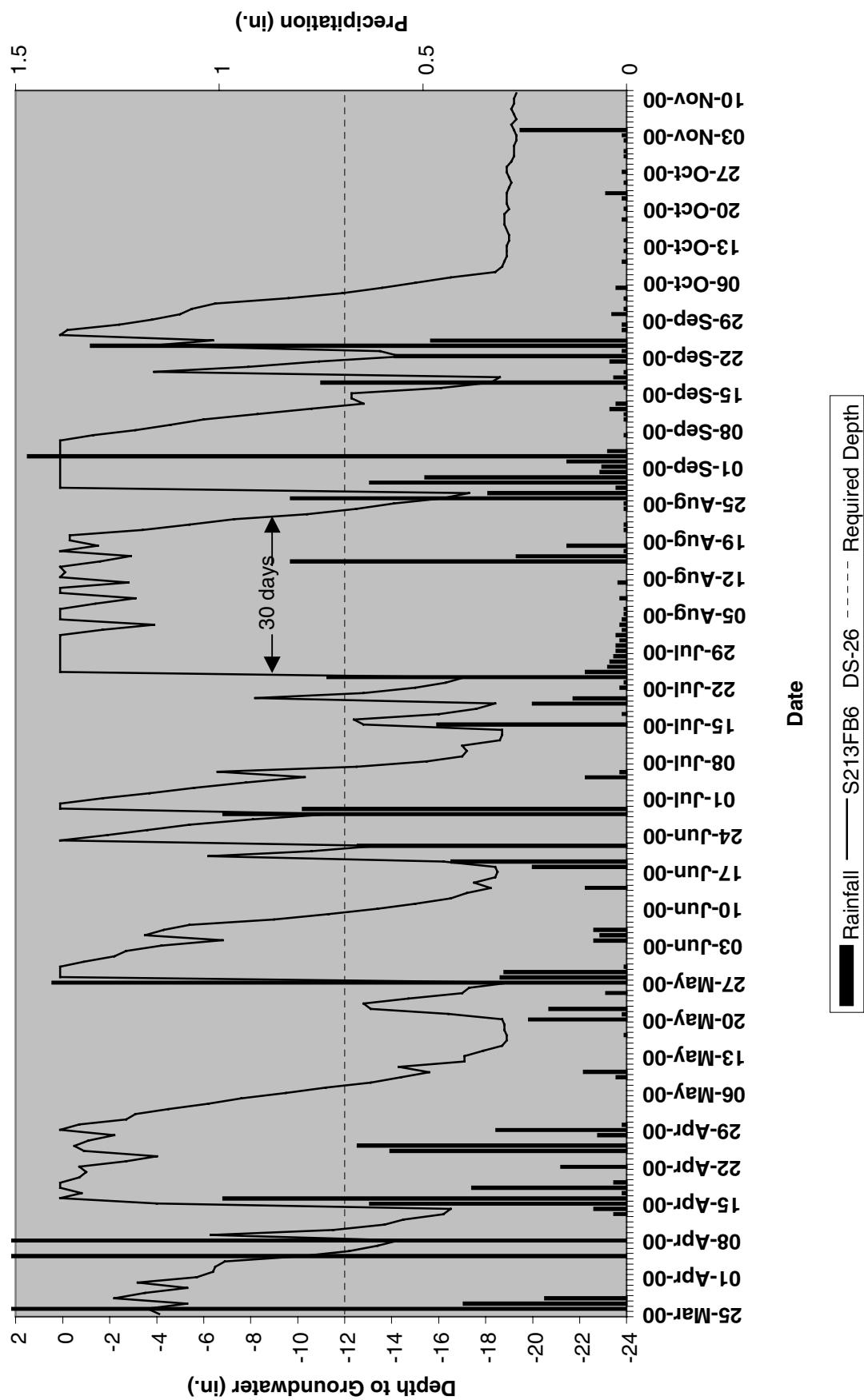
Dismal Swamp-G24

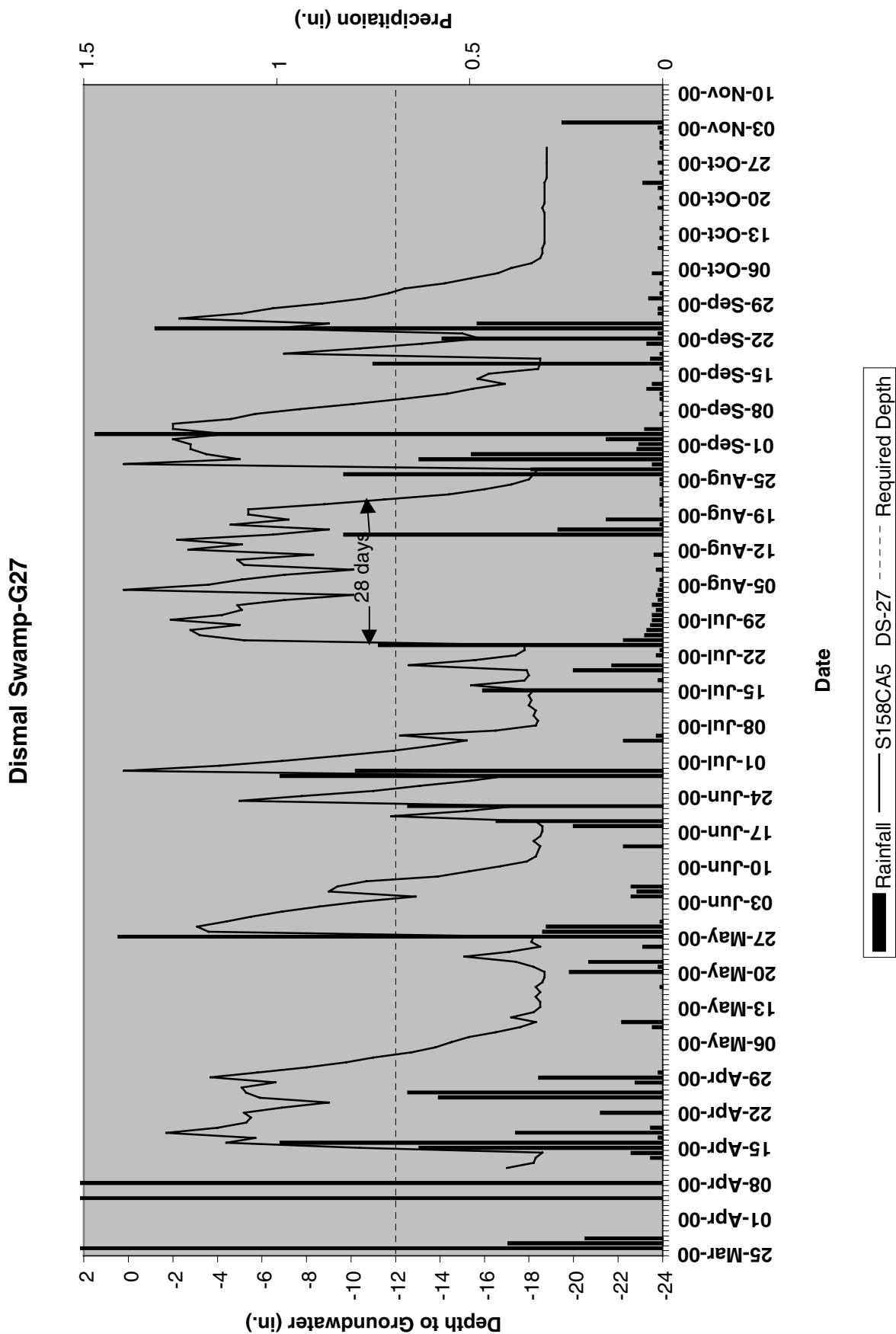


Dismal Swamp-G25



Dismal Swamp-G26





APPENDIX B

SITE PHOTO

DISMAL SWAMP



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

DISMAL SWAMP



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12

APPENDIX C
VEGETATION PLANTING PLAN

DISMAL SWAMP MITIGATION SITE PHOTO AND PLOT LOCATIONS

2000 MONITORING

